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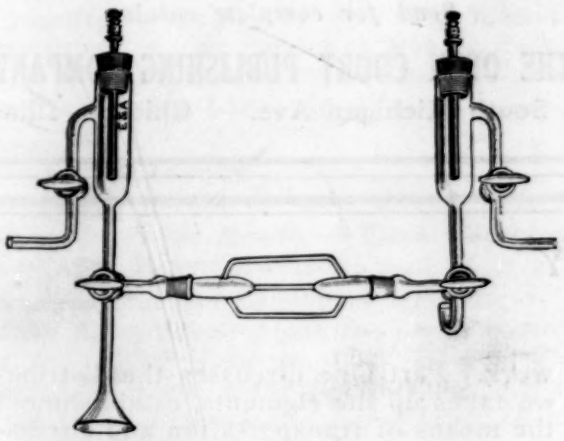

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BIOLOGY AND THE TRAINING OF THE CITIZEN[1]

I PROPOSE in this address to depart somewhat from precedent and to devote it neither to a general review of recent progress in our science, nor to the exposition of my own special views on problems of evolutionary morphology, but rather to a more general subject—one which I believe to be at the present time of transcendent importance to the future not merely of our nation but, indeed, of our civilization—namely, the relation of biology to the training of the future citizen. Speaking as I do from this chair, I need hardly say that by biology I mean more especially animal biology.

It is unnecessary to emphasize at length the enormously important part which biological science plays in the life of our modern civilized state. The provision of food for the community—crop-raising, stock-breeding, the production of dairy products, fisheries, the preservation of food by canning and freezing, and so on—is obviously an immensely complicated system of applications of biological science. And so also with the maintenance of the health of the community—the prevention of disease, much of which is now known to be due to the machinations of parasitic microbes, often transported and spread by other living organisms, and the cure of disease by the modern developments of medicine and surgery—these again are applications of biological science. When we contemplate merely such simple facts known to every one, when we see to what an extent the results of biological science are woven in and out through the whole complicated fabric of modern civilization, when we contemplate further the gigantic expenditure in money devoted to the school training of our future citizens, it must surely strike us as an extraordinary fact that biological science enters hardly, if at all, into the school training of our average citizen.

What I have said indeed applies, if only in lesser degree, to the subordinate position occupied by science as a whole in our school training. In the early stages of human evolution, as we see illustrated on the earth of to-day by those comparatively primitive savages who still remain in the nomadic hunting phase, what we should now call science plays an all-important part in the education of the young indi-

[1] Address by the president of Section D—Zoology—of the British Association for the Advancement of Science, at Oxford, England, August, 1926.

vidual: he is taught to observe accurately the phenomena of nature, dead and living, to draw the correct conclusions therefrom, and to regulate his actions accordingly. In our own early history science undoubtedly played an equally important part in the training of the young. Even down into the Middle Ages it supplied an appreciable part of the curriculum of the educated man, the seven liberal arts of these days containing a large infusion of what we now call science. In later times, however, from the renaissance of classical learning onwards, science has been kept in the obscure background of our educational curriculum, and in spite of much tinkering of detail in recent years that curriculum continues unchanged in its main features: it remains preponderatingly literary and classical. Even to-day, if we listen to contemporary discussions on education, we commonly hear arguments as to the relative merits of different constituents of the current curriculum, but the general framework of that curriculum seems to be regarded as sacred from all interference.

And yet these recent years have witnessed the most tremendous advances in the evolution of our social organization, and, as the position now is, it seems as certain as anything can be that unless further advance is accompanied by a corresponding evolution in the training of our future citizens a condition of instability will soon be reached such as to involve the risk of complete disaster. Probably the factor in our modern social evolution which has brought in its train the greatest danger is the development of what in general terms we may call means of intercommunication—the means by which transport is effected—on the one hand of material things, on the other hand of ideas. Primitive man in the hunting phase of his evolution is a nomad, but a nomad within a restricted area: his wanderings are limited by the more or less vague boundaries between his own territory and that of neighboring tribes. He is entirely dependent for food and raiment upon what nature provides within these limits: he knows little of the world beyond except that it is peopled by strangers of varying degrees of hostility: his code of ethics is limited by the same boundaries—highly developed as regards intercourse with his own tribe it ceases to exist in his intercourse with those outside. His dominating idea is loyalty to his own kinsfolk and fellow tribesmen, and for this idea he is ready to make any sacrifice.

With advancing evolution, when the communal unit is no longer the clan or tribe but the nation or federation of nations, geographical and political boundaries still exist; but with the evolution of means of transport by road and rail and sea they cease to form impassible barriers—men and goods are able to pass them freely. Of even greater moment to citizenship than the transport of material things is the transmission of ideas. The great developments in this have come about in the first place with the evolution of language, the vehicle of thought, which has rendered possible the transmission of thought from individual to individual. The use of visible material symbols of a lasting kind—whether pictorial or simply conventional, as in writing and printing—while facilitating still further the transmission of thought from individual to individual and from place to place, has done far more, for it has enabled the achievements of each generation to be handed on to its successors with a completeness that was quite impossible by the merely spoken word.

While these advances in the methods of transmitting thought have played an all-important part in rendering secure the orderly progress of human knowledge, they have brought in their train curiously one of the most potent disturbing factors to the progress of communal evolution. This disturbance is brought about through interference with the workings of one of the great principles of communal evolution —that of leadership.

LEADERSHIP

Already in the primitive tribal community we find this factor at work. Tribes differ in their size and power—their men may number a mere half dozen or several hundreds—and the main factor in this is the personality of the tribal chief. Among his own men the chief stands out by his capacity, mental and physical: a quick and accurate observer, he is also quick and accurate in drawing his deductions: he is wise, he is rich in knowledge and in its bearings; while alert and quick in decision, he is of steady nerves, has a good sense of balance and is reliable in emergency.

And so it is onwards through historical evolution—the chief, the ablest man of his tribe, finds his successors in a long sequence of natural leaders of men.

It is the more modern developments concerned with the transmission of thought—printing, telegraphy, wireless telephony, cinematography, and so on—that constitute the great disturbing factor, inasmuch as they have given enormously increased importance to elements of individual personality quite distinct from general strength and capacity, mental and physical. Amongst such elements there stand out conspicuously oratorical power and skill in the method of advocacy. The leader no longer forces himself to the front by the sheer power of his outstanding constructive ability; the place of this is to a great extent taken over by the power of effective and persuasive writing and speaking. The most responsible posts in the

leadership of the modern state have been rendered accessible to the skilled orator, even though his constructive ability in statesmanship may not be of the highest. That this development involves serious dangers is obvious; it seems equally obvious that one of the main tasks confronting the community is the devising and setting up of the educational safeguards which alone can be efficient against these dangers. The task will, indeed, be no easy one: it will clearly, for its satisfactory accomplishment, call for the best intellects the community can provide. However great the ability of those to whom the task is entrusted, it will prove one of high complexity and much difficulty; but certain inevitable conclusions seem to be visible, one of the chief of these being the need of drastic cutting down of the number of subjects at present inflicted upon the young citizen in training during his school period. How exactly this is to be done will have to be carefully worked out; but it seems clear that at present an immense amount of time is given, during the early stages of the curriculum, to subjects which might profitably be replaced by others of greater value in mind-training during these earlier stages. If postponed to a later stage of mental development such subjects can be mastered in a small fraction of the time required in the earlier stages—when, by the way, their prolonged and wearisome study is but too apt to kill effectively all interest on the part of the pupil in the particular subject.

While I am in complete agreement with those who desire to see the school curriculum greatly lightened as regards number of subjects and who desire to see "snippets of many subjects" replaced by more thorough training in a few, my special task now is to urge the necessity of including in the training of every citizen before the completion of his school period at least a grounding in the main principles of biological science.

It is necessary in approaching any such question to keep clear in our minds the two main functions of education: (1) the educative function in the strict sense—the training and development up to the highest attainable level of the brain-power which nature has provided, and (2) the informative function—the providing the mind with an equipment of information which will be of use to it later on.

SCIENCE AND THE CURRICULUM

It is again necessary to glance for a moment at the general question of science in relation to education. I, of course, believe that the almost complete exclusion of science from the elementary education of the young which has persisted over a prolonged period has been a real tragedy. In the life of the ordinary active citizen, as opposed to that of the mere scholar and recluse, some of the most important factors are those which training in science is specially adapted to develop. Such above all are the powers of accurate and rapid observation, and of the accurate and rapid drawing of conclusions from observation.

But I do not support the claim of biology to an important place in the basic stage of school education, which should have to do with the early development of these powers. On the contrary, I harbor no doubt in my mind that the department of science to be used for this purpose is not biology but physical science. For the early training of the powers of observation there are two essentials: (1) that the phenomena observed should be capable of numerical expression to a high degree of accuracy, or, in other words, that they should be measurable; and (2) that a given observation should be capable of repetition over and over again under approximately the same set of conditions. Biological observation fails as regards both of these essentials. When we proceed to apply the method of measurement to something that is alive or that has once been alive, or to some form of vital activity, we find ourselves confronted not with a phenomenon of comparative simplicity, but with a complex of extreme and, in great part, unknown intricacy. If we measure the length of marks upon a piece of paper, or of similar rods of a particular metal, we obtain by so doing data of a totally different order of scientific reliability from those that we obtain by measuring the length of some particular animal, where the particular dimension is the visible residuum left at the end of an immense chain of events during the racial and the individual history of the animal. While such measurements may provide important material for the skilled biometrician, they are, as I believe, totally unsuited for use in elementary education. And a somewhat similar consideration affects the *repetition* of observations upon living things or upon things that have lived—the observable phenomena result from the interaction of so many imperfectly known factors, and are so liable to the influence of disturbing forces, that it is difficult or impossible to repeat observations with any assurance that all the conditioning factors are really the same.

It is rather in the later stage of education—the informative stage—when the individual has already had his powers of observation and reasoning developed in the earlier stages, that biology should be called upon to play its rôle.

What is required is by no means the storing of the memory with a vast array of separate facts. It is rather that the budding citizen should be given a grasp of broad principles, as accepted by the competent authorities of the day. Such broad principles are generalizations from immense masses of detail.

The probable soundness of the generalization is intimately related to the broadness of its basis of fact. It is, of course, impracticable to place before the pupil the entire body of facts that constitute this base, and if it were possible it would be useless, for it is only a master who is able to perceive clearly the relations of superstructure to base. The object of the teacher is then not to attempt the vain task of demonstrating the truth of the general principle in the short period available: such facts as are introduced should serve merely to illustrate the particular principle and facilitate its appreciation.

I know that there are many who will criticize as unscientific and unsatisfactory such a simple manner of approach to general principles. They will say you can not really instil such principles unless you make the pupil go through an elaborate course of laboratory training in dissection and microscopic observation such as we impose upon the specialist student of biology. I do not agree. My experience has been that an audience, whether of youths or of adults, of ordinary average composition such as we get in a public lecture in a big industrial city, appreciates the points and follows the argument perfectly satisfactorily without such elaborate preparation, provided always that the argument is clothed in plain, non-technical English.

BIOLOGY IN THE CURRICULUM

The question may now be put: What exactly are the biological facts and principles that should be introduced into such a course of instruction?

I. Firstly, the great fact of evolution. We still see with tiresome frequency in magazine articles the statement that evolution is not a fact, but merely an unproved hypothesis. No doubt it may be said with perfect accuracy that in one sense absolute proof is unknown to science, except in relation to successive steps of an operation in pure mathematics. Taking, however, the word "proved" as we use it in ordinary life, *e.g.*, in relation to a matter inquired into by a court of law, then we are completely justified by the data of embryology and paleontology in stating that evolution is a definitely proved fact. The realization that it is a fact admitted by all competent judges should be incorporated in the mental equipment of every citizen at an early stage of his training.

II. Secondly, the broad fact of inheritance: the fact that the offspring repeat the characters of the parent—physical, mental, moral—but that this repetition is never so complete as to amount to identity as regards such characters. It is not always realized that, were the repetition actually exact and complete, it would constitute a fact that would shake our whole biological philosophy to its foundations!

The voyager upon the open ocean often sees a towering wave approaching his vessel, overwhelmingly impressive in its seeming individuality, and yet we know from physics that that onwardly rushing wave is merely an apparent form, its outward semblance cloaking a comparatively gentle heave of the constantly changing particles of water. Or, again, one sees a cap of cloud covering a distant mountain peak. It seems to remain unchanged for hours, and yet we know it is undergoing constant change—water particles separating off on its leeward, and others being added on its windward, side. So it is with every mass of living substance: active interchange of substance—regarding much of the details of which we are profoundly ignorant—is constantly taking place not only between different parts of itself, but also between itself and its environment. It is this swirl of activity that constitutes life, and it carries with it the necessary implication that a bit of living substance is never the same at two separate instants of time, nor two separate bits of living substance ever identical in detail with one another. As soon might we think of constancy in a flickering candle flame as in substance that is alive. And how, in view of this lack of constancy in all that lives, could we expect the progeny to be exact repetitions of the parent? How could we expect them to be otherwise than different from one another? If I would emphasize this point, commonplace though it will seem to many, it is because of the widespread tendency to ignore it even amongst biologists themselves.

The biologist constantly using the species as his classificatory unit involuntarily becomes dominated by his mental picture of the ideal member of the species, conforming exactly to description, and an individual which obviously does not so conform impresses him as a departure from his ideal. He comes in this way to think of variation as being an active positive process by itself, instead of an inherent characteristic of life and of inheritance. It would not occur to him to decry the science of physiology because it does not know the ultimate nature of the phenomena of life with which it deals, but yet he will sometimes attempt to discredit our evolutionary philosophy because it is similarly without any clear idea as to the ultimate nature and cause of the variation which is the necessary accompaniment of life.

This instability of living things which finds its expression in the constantly fluctuating incompleteness of inheritance has to be driven well home—in the first place because it constitutes the raw material of evolutionary progress, and in the second place because its proper appreciation provides the citizen with his surest safeguard against the talk of those who make it their business to belittle, if not to deny, the ever-

present differences in the capacities of their fellowmen.

III. Thirdly and lastly, the fact of the struggle for existence in nature and the consequent elimination of the less fit. To the biologist and, indeed, to any one who devotes thought to the matter, the struggle for existence and the consequent elimination of the unfit is an obvious truism, apart altogether from the question whether or not he accepts the Darwinian view of its potency as a factor causing evolutionary change; but yet among our fellow-citizens interested in sociological questions there is a very prevalent lack of appreciation of the widespread nature and the intensity of the struggle, induced in many cases by the perusal of charming descriptions of mutual aid in the animal kingdom, combined with ignorance of the fact that such mutual aid is restricted to the individuals of a community and is actually an important factor in rendering the community efficient in holding its own in the struggle with other communities.

When once the pupil has fully grasped the three great primary facts I have mentioned, he can profitably pass on to elementary notions of the biology of communal life. Gateways leading to these may be found by way of the fascinating phenomena presented by communities of social insects such as bees and ants and termites. Still better in some ways is the study of cell-communities, culminating in the immensely complex cell-communities that constitute the bodies of the higher animals. By whichever route, the pupil is easily led to the three great principles of communal evolution: (1) increase in the size of the community, (2) increased specialization of its constituent individuals, (3) increased perfection of the organization by which the constituent individuals are knit together into the communal individuality of a higher order. In some animal communities this organization is of a material kind, the individuals being linked together by strands of living substance, in others the connection is not material but is of the nature of social interrelationships.

When once these basic principles are clearly apprehended an approach may profitably be made to the study of human society, where the same principles are seen clearly at work—the simple nomadic group with its individuals few in number, showing hardly any trace of specialization and so loosely knit together that they separate from one another under stress of circumstances, such as attack by a hostile tribe—leading up to the complex modern civilized state with its millions of inhabitants, intensely specialized for the performance of the various communal functions and knit together by an immensely complex social organization.

The Intercommunal Struggle

The appreciation of the fact that our civilized community has come about by a long process of social evolution paves the way to an appreciation of the further fact that human societies are still in process of evolution—states becoming larger and larger, the specialization of their citizens becoming ever more pronounced, their social organization more complicated—and that here again a great driving force is the struggle for existence, in this case an intercommunal struggle.

It is surely one of the saddest experiences a biologist can have, to live amongst men whose communal evolution has lagged behind, and to see how, unless helped in their struggle with competitors at a higher level of social evolution by some natural protective feature such as geographical isolation or immunity to local diseases, they are doomed to disappear. Innumerable examples of this are seen in the continents of the New World, where the relatively primitive communities of red men have been displaced by whites in a higher stage of communal evolution. The same process has taken place in the past, races that lagged behind in their communal evolution giving place to others more progressive.

The realization of the importance of intercommunal and interracial competition is of use indirectly as a safeguard against falling into the common error of ignoring differences—in material interests, in racial prejudices, in religious beliefs—those troublesome factors which, in actual practice, form serious obstacles in the way of those who would find in signed agreements between different nations a sure shield against the danger of war.

The Biological Outlook

Finally, our training, if successful in inducing in our citizen's mind what we may call the "biological outlook," enables him to take a fresh and an enlightening view even of that distressful subject, economics. He appreciates more fully how the customary units of the economist, pounds and dollars, are merely tokens with local values dependent on their power of purchase. In a remote spot on the earth's surface, a pile of golden coins becomes merely so much workable material out of which articles useful or ornamental may be fashioned; a bundle of scrip becomes material of possible use for kindling a fire. Their actual value bears no relation whatever to their token value in other circumstances.

Our citizen from his biological viewpoint looks beyond this veil of make-believe and realizes that the true unit of value is the capacity of the human individual. He sees in each individual a biological capitalist. His store of capital may be small or

large. It may consist of the precious bullion, intellectual power or the humbler metal, bodily strength. And the store, small or great as it was to begin with, may have been simply left like talents buried in the earth, or by education it may have been increased in amount and coined into the kind of currency, such as skill in handicraft or other form of social activity, which gives it its greatest local value in the community.

TO WHAT END?

But how the question may fairly be put: what good would come of it all were the biologist given his way, and his subject, resting on a basis of elementary physical science, accorded the place in the ordinary school curriculum that he claims for it? How might it fairly be expected to work out in practice to the advantage of the community and of the individual citizen?

To state adequately the answer to this question would exhaust the time not merely of one address but of many, and I can only indicate one or two points which the answer would include. The scientific training we are arguing for would in the first place be a potent power on the side of social stability, inasmuch as it would help to develop the scientific habit of mind with its constant distrust of the ably stated "case." There is no more potent defense against the plausible rhetoric of the advocate than infusion of the scientific habit of bringing verbal statements up against the touchstone of actual fact.

With recognition of the principle that the welfare and happiness of the individual citizen is by no means independent of the material prosperity of the community, proper appreciation would be given to biological economics. It would be recognized that the training of the individual citizen must include the scrutiny of the nature and amount of his biological capital and the taking of appropriate measures to increase his stock and to ensure its being minted into the most suitable form of currency.

Individual scrutiny would in turn drive home the necessity of confining within as narrow limits as possible the workings of the principle of mass production in education. The application of that principle plays a great part in industry, but its introduction into the sphere of education is apt to be accompanied by forgetfulness that its success in industry is entirely conditioned by one basic factor, namely, uniformity of raw material. Without such uniformity the practice of mass production is recognized as absurd. The clearer realization how completely wanting this uniformity is in the human raw material on which education works will serve to impress upon us all the desirability of confining mass education within the narrow limits at the commencement of the educational period when it is for practical reasons unavoidable.

The fostering of the biological element in education would do something to quicken into renewed life the primitive relationship of parent and offspring which has tended to become deadened under the influence of modern civilization and more especially of mass education. The parent would be no longer encouraged to regard his child as merely number so-and-so in a vast number of units poured into the hopper of the educational mill. He would be encouraged to keep up his natural sense of responsibility for the welfare and interests of his offspring—the slackening of which in our present system is responsible for so much that is deplorable—and incidentally he would be stimulated to take a live interest in the education of his children, in the selection of those responsible for the ordering of that education, and in the subject of education as a whole.

This greater interest would lead him to a better appreciation of many things connected with education. One of those of which a deeper appreciation is greatly needed has to do with the reciprocal relations of physical and mental deportment. Passing along a city street the biologist is constantly having his attention caught by little peculiarities of attitude and movement which reveal to him the existence of peculiarities of quite another kind—stability or instability of character, mental sluggishness or alertness. He realizes to the full that there is a reciprocal relation between mind and body. With the spread of the biological outlook through the community this realization would become general, and we should have the average parent awakening to the full appreciation of the fact that he is inflicting grievous harm upon his children if he fails to see to it that their ordinary education is accompanied by the full allowance of physical training and games, which, while developing physical activity in the first place, plays a great part in developing mental alertness as well.

The training of the individual to the highest attainable degree of biological aptitude as a citizen involves naturally his relations to other members of the community. He must be fit not merely to play his part as an isolated individual, but also to carry out smoothly and efficiently his communal activities. As communal evolution progresses, these latter relations become relatively more and more important. In the primitive savage phase the individual is still subject to the ruthless pressure of natural selection. His whole organization—his bodily health and strength, the acuity of his senses, his mental alertness—is kept up to the highest pitch. As communal evolution goes on, however, the pressure of natural selection becomes

modified. In one particular respect no doubt it becomes intensified, for the crowded community provides greatly increased liability to the attacks of pathogenic microbes, and consequently we find active evolution proceeding in the direction of increased immunity to such as are prevalent and dangerous. It is a hideous experience to witness the immigration of people from a more highly evolved society with their accompanying microbes into the midst of a remote and primitive community and to see the horrible ravages these microbes produce when disseminated amongst the virgin population. While, however, in this particular respect evolution proceeds actively in the more advanced communities, it is not so in other respects. The individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. As a result, as seems beyond question, the individual necessarily deteriorates with high civilization in his all-round fitness both mental and physical, and this retrogression renders him correspondingly more and more dependent upon the community for his welfare. Emerging from this consideration, we have the conclusion that with higher and higher communal evolution, with more and more intimate dependence of the individual upon the community, we should have greater and greater attention paid in our educational system to these subjects which have to do with the citizen's relations to and duties towards the community—such as discipline, ethics, patriotism and loyalty to country and comrades, and the past history of the community and race.

The last of these, in fact, the history of our race, is one of the subjects of the present school curriculum which the biologist would be particularly anxious to see retained, and even accorded increased importance. His natural sympathies go out to it, for his own philosophy—evolution—is but history of a larger growth. No doubt he would sometimes wish its teaching to be modified in detail: he would like to have less attention devoted to brawls and murders—on however great a scale—and to have a little space spared for the achievements of science. In my own town of Glasgow I often wonder how much the average child is taught regarding the two great events of the world's history which took place in that city—James Watt's improvement of the steam engine and Joseph Lister's inauguration of antiseptic surgery.

In these flippant days there is a tendency to scoff at pompous lines regarding "lives of great men," and so on; but are we quite sure that our children are not greatly the losers by hearing so little in their school days regarding the dedicated lives of great heroes of science like Darwin or Lister?

In this address, which I must now draw to its close, I have touched upon some of the general considerations which naturally come to the mind of the biologist when he thinks of his subject in relation to this great and, as it has become, vitally important problem of the training of the future citizen. Some matters that at once suggest themselves I have deliberately avoided: Eugenics—there are others who speak of that; sex—the whole air is abuzz with discussions on sex. The importance of every citizen being given a little elementary knowledge of the biological aspects of health and disease; the importance of the school paying more attention than it generally does to training the power of prolonged and concentrated effort upon dull bits of work; neither of these points requires any special emphasis.

There are, however, many other aspects of the problem which I refrain from developing, only because forbidden by the tyrant time. Summing up the more important of these, I would say that the biologist would like to see a movement of our whole educational system away from the merely literary, doctrinaire, academic regions, in which it is apt to be out of touch with the reality of biological fact and practical affairs. He would like to see a far more general recognition of the fact that the primary object of education is to make the individual able rather than learned. A learned individual may be, and often is, a stupid one. And in any case the development and the training of general brain-power fits biologically into the earlier years of life in a way that is not the case with the acquirement of mere learning.

He would regard as another prime object in the training of the citizen the getting him back towards the primitive habit of thinking constantly. The primitive savage is kept constantly alert by ever-present danger. He is constantly thinking about the meaning of what he sees and hears. Civilized man, freed from the stress of savage life, gets into the habit of not thinking. His actions become automatic. He gulps down whatever is served up to him. If he were only to think he would promptly discriminate as to what is worthy of acceptance and what is not.

The biologist would like to see still another reawakening of ancient custom, namely, the more effective shackling of personal liberty in the bonds of duty towards the community. Amongst primitive men one finds a high degree of personal freedom, but this is bounded strictly by the interests of the community. These interests are regarded as sacred, and the offender against them receives prompt and severe punishment. Throughout the long ages of social evolution, the traitor—the blackleg to his country—has ever been regarded as the most despicable of men, and it is a new and strange development of modern times that toleration is extended to those who delib-

erately work an injury to their country and kindred—it may be on the grounds of their own material interest. A biologically educated community, while according to the individual in his ordinary affairs the widest range of personal freedom, would take measures to prevent effectively its interference with the public welfare, whatever might be the form of this interference.

There is one other argument I would use for the biological factor in training the citizen. As social evolution progresses, the natural differences between men become more and more marked, as does also the material expression of these differences. One individual—say a Lister—is worth to the community many millions of pounds; another is worth little or nothing, or in some cases his value may be expressed by a negative quantity. And along with this increase of inequality there comes, unhappily, the deteriorating nervous balance which accentuates discontent and social friction.

The biological outlook I believe to furnish a most potent aid towards the smoothing away of such social difficulties and the lubrication of the social mechanism, for it enables us to see with clear vision through the obscuring veil of superficiality that separates class from class, and shows us how our fellow-citizens beyond, in spite of their differences in manners and clothes and language, are after all, on the average, merely human beings like ourselves, fitted out with the same strengths and trammelled by the same weaknesses as our own.

J. Graham Kerr

University of Glasgow

AN INTERNATIONAL COMMITTEE ON BOTANICAL NOMENCLATURE

The International Congress of Plant Sciences, recently in session at Ithaca, New York (August 16 to 23), held its meetings in several sections, one of which was taxonomy. The program for this section provided for several sessions, three of which were set aside for a round-table discussion on nomenclature, with Mr. A. S. Hitchcock in charge.

At the first meeting of the round table, Thursday afternoon, the chairman placed before the meeting for discussion: (a) The proposals adopted by the Imperial Botanical Conference held in London, 1924 (presented at the Ithaca meeting through Dr. A. B. Rendle); (b) the resolutions adopted by the Botanical Society of America at the Kansas City meeting (1925); (c) certain generic names, suggested for addition to the list of nomina conservanda, presented by the Committee on Australian Botanical Nomenclature, through Mr. Sprague (Kew); (d) a paper on Standard-species of Nomina Conservanda by M. L. Green, presented by Mr. Sprague. These proposals were written on the blackboard for examination by the audience.

Four invitation papers were read by Dr. John Briquet, Geneva, Switzerland; Mr. T. A. Sprague, Kew, England; Dr. M. L. Fernald, Gray Herbarium; Dr. M. A. Howe, New York Botanical Garden.

At the suggestion of the chairman the proposal for an international committee was first taken up for discussion. The section decided that such a committee be chosen by a temporary committee of five appointed by the chairman, providing that one member should be the chairman, that two others should be Dr. Briquet and Dr. Rendle and that the remaining two members should have special knowledge of cryptogams. At the Brussels meeting (1910) of the international congress, there was appointed a permanent committee on nomenclature, consisting of Briquet (Geneva), rapporteur general, Harms (Berlin), vice-rapporteur, Rendle (London) and Mangin (Paris). Briquet and Rendle, the only members of this committee present at the Ithaca meeting, were asked to serve on the appointing committee in order to coordinate the new international committee with the old permanent committee of the Brussels Congress, which had certain duties in preparing material for the London Congress (intended to be held in 1915 but delayed and now planned for 1930). The chairman asked Dr. Briquet and Dr. Rendle to suggest the cryptogamic members of the appointing committee, which suggestion was followed. The appointing committee consisted of Briquet (chairman), Rendle, Arthur, Ostenfeld and Hitchcock.

On motion of Dr. Hill (Kew) the meeting adjourned until Friday evening in order to give the committee time to make its selection.

On Friday evening the appointing committee reported, proposing an interim Committee on Nomenclature, consisting of twenty-nine members, including the four members of the old permanent committee mentioned above. The report was adopted by the section on taxonomy and sanctioned by the congress at a general business meeting. It was provided also that the officers of the original committee (Briquet, chairman; Harms, vice-chairman) should be the corresponding officers of the interim committee. The interim committee consists of:

Barnhart (New York), Bitter (Goettingen), Black (South Australia), Briquet (Geneva), Degen (Budapest), De Wildeman (Brussels), Diels (Berlin), Domin (Prague), Fedtschenko (Leningrad), Harms (Berlin), Hitchcock (Washington), Jaczewski (Moscow), Janchen (Vienna), Lecomte (Paris), H. Lindberg (Helsingfors), Maire (Algiers), Mangin (Paris), Moss (South Africa), Murbeck (Lund), Nakai (Tokyo), Ostenfeld (Copenhagen), Ramsbot-

tom (London), Rendle (London), Robinson (Cambridge, Mass.), Schinz (Zürich), Shear (Washington), Sprague (Kew), Trotter (Florence), Valeton (Leyden).

This committee will consider proposals for amending the International Rules of Nomenclature and will make recommendations to the next international congress to be held in London in 1930. At an early date the chairman of the interim committee, Dr. Briquet, will issue a circular containing directions for preparing proposals which are to be submitted to the committee.

The official program of the congress stated that "the Congress does not provide an occasion for legislation on regulatory matters." Hence no action was taken on the proposals discussed, but the way is now open for presenting these and other matters to the London Congress through the new interim committee.

A. S. HITCHCOCK

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

THE LEAGUE OF NATIONS COMMITTEE AND INSTITUTE OF INTERNATIONAL INTELLECTUAL COOPERATION

AMONG the several continuing special commissions and committees of the League of Nations the International Committee and Institute of Intellectual Cooperation have a particular interest for scientific workers.

The special function of the committee and institute is the promotion of international undertakings in the various fields of scholarship. They interest themselves in university conditions and relations; in the international exchange of professors and students, the international equivalence of diplomas, the development of an international association of universities and of international associations of students; in the international relations of libraries, bibliographic services and museums. They are interested in the proprietary rights in his work of the author, artist and scientific discoverer. They hope to be able to find means of giving some special support to scholarly undertakings in countries facing particular difficulties in this regard. They have stimulated the establishment of thirty national committees, in as many countries, to maintain helpful relations with the central international committee, and to encourage the participation of these countries in international intellectual activities.

With the prestige of the League of Nations behind them the committee and institute can take up matters of scholarly and general intellectual interest directly with governments, and can hope to obtain special governmental support for the holding of international congresses and reunions of international groups of experts for the study of special problems of intellectual life common to many nations.

The membership of the League of Nations Committee includes such widely known names as those of Mme. Curie, Einstein, Gilbert Murray and R. A. Millikan. The present president of the committee is Professor Lorentz, of Leiden, who succeeds Henri Bergson, forced by ill health to resign both the presidency and his membership in the committee. The fourteen members of the committee represent fourteen countries, and meetings of the whole committee and of the four or five continuing sub-committees so far organized are held at least annually.

But no matter how capable, distinguished and devoted the members of a committee with such interests and aims as this one has, there is necessary, for definite achievement, some sort of a continuously working agency competently organized and equipped to carry forward to realization the recommendations outlined by the committee. This agency the League of Nations Committee now has in the International Institute of Intellectual Cooperation, organized in January of this year and now actively at work.

The institute has a director and vice-director, ten chiefs and assistant chiefs of sections, all serving full time, and, in addition, a number of occasional special investigators serving for limited periods. There are sections of university relations, scientific, literary and artistic relations, a legal section and a section of information. The institute hopes, especially, to act as a general clearing house for information concerning intellectual activities all over the world. Although the institute is situated in Paris, which offers more and larger library and informational advantages than Geneva, and is so far chiefly supported financially by the generosity of France—Poland and Czecho-Slovakia have made it small appropriations—it is thoroughly international in spirit and make-up and is entirely under the control of the League of Nations Committee.

The annual summer meeting of the committee and its sub-committees has just been held in Geneva. The director, vice-director of the institute and two or three of its section chiefs were in attendance. Two public sessions of the full committee were held, and at most of the private sessions of the committee and sub-committees, which extended through a fortnight, special experts in various fields of the committee's interests were in attendance by invitation.

In the absence of Professor Millikan, the present writer acted as American representative, as was also the case last summer. From the experience of these

two meetings, and from a personal knowledge of the work now under way by the institute and definitely planned for the immediate future, I am convinced that the committee and institute are playing a useful rôle in the advancement of international intellectual cooperation and hence of internationalism in general. This rôle can be enlarged as time goes on, especially if a larger financial support for the institute can be found.

VERNON KELLOGG

GENEVA, SEPTEMBER 3

SCIENTIFIC EVENTS

THE BRITISH INSTITUTION OF FUEL TECHNOLOGY

AT a meeting last spring at the Institution of Civil Engineers it was resolved to found an Institution of Fuel Technology. The work of preparing a constitution was left to an organizing committee. Sir William Larke presided recently over a second meeting to receive the report of the work of the committee.

According to the report in the London *Times* the chairman read a letter from Sir Alfred Mond, who has accepted the office of president, in which, after expressing regret that he was unable to attend, he said: "The work which the institution has set out to do is of the utmost importance to industry, and indeed to the whole commonwealth. Under the conditions in which the country has been existing during the last few months public interest has become more and more concentrated on the problems which the institution has been formed to solve."

A suggestion had been made that the new institution and the Institution of Fuel Economy Engineers should, if possible, combine. The Institution of Fuel Economy Engineers, however, stipulated that the basis of membership should be some technical or professional qualification. So that membership of the new institution should confer a status, it was requested that there should be provided at least one class of definitely qualified members.

Speaking for the organizing committee the chairman stated that: "It could not be too strongly emphasized that the objects of the institution were to promote, foster and develop the general advancement of the various branches of fuel technology as an end in itself. To do that it was considered desirable to enlist the support of all those having any interest in fuel, and not to limit membership by any restrictions as to technical or professional qualifications, but to maintain the prestige and standard of the institution by the character and nature of the papers presented under its auspices and by the election of a strong council representative of all interests. The constitution had been so designed as to secure facilities for cooperation with all existing institutions having fuel interests. It had been proved conclusively that there was need for an institution which would bring all sections of workers in fuel and fuel problems into a closer relationship."

The following were elected to the offices specified:

President.—Sir Alfred Mond.

Vice-presidents.—Lord Aberconway, Professor Harold Baily Dixon, Sir Robert Abbott Hadfield, Lord Weir and Mr. D. Milne Watson.

Council.—Mr. R. A. Burrows, Sir Philip Dawson, Mr. F. A. Freeth, Sir W. J. Larke, Mr. Rudolph Lessing, Mr. M. Mannaberg, Sir Edward Manville, M.P., Mr. S. McEwen, Lord Montagu of Beaulieu, Sir Richard Redmayne, Admiral Sir Edmund Slade, Mr. Wallace Thorneycroft, Mr. M. W. Travers, Professor R. V. Wheeler, Mr. W. A. Woodeson, Mr. G. R. Thursfield, Mr. T. Hardie, Mr. A. H. Middleton and Mr. W. M. Selvey.

Honorable Treasurer.—Sir William B. Peat.

Honorable Secretary.—Mr. Edgar C. Evans, Caxton House (East), Tothill-street, S.W.

It was left to the council to fix a date for the autumn or winter meeting at which, it was stated, papers of considerable importance would be read.

A PAN-PACIFIC EXPOSITION

JAPAN is to have a Pan-Pacific Exposition in 1929. On March 25 Mayor Tasaka together with Mr. Beppu, expert in the organization and management of exhibitions, and Mr. Sangu, Vice-Mayor, visited Governor Yamawaki and laid before him the plans for the Pan-Pacific Exposition to be held in Nagoya during the spring and summer of 1929. The exposition will be held under the united auspices of the prefecture and the City of Nagoya. An organization will be formed shortly to handle the business connected with the exposition.

The final plan calls for an expenditure of Y10,600,000, of which Y3,000,000 will be contributed by the city and the province. In magnitude the proposed exposition will more than double the Peace Exposition held in Tokyo in 1921. Halls of Industry, Art, Agriculture, Stock, Forestry, Maritime Products, Minerals, Machinery, Electrical Apparatus, Communications, Social Service and Social Culture will be erected. The buildings, including the projected City Hall which will be used for the offices of the exposition, will cover nearly 25 acres.

Between six and seven acres of space will be allotted to foreign exhibits from the shores of the Pacific, and the exhibits of home products will more than double those of the present Osaka Exhibition. About 240 acres will be set aside for the exposition grounds, which will be located in four different districts. Several of the buildings are to be permanent structures and the remainder are to be built in such a

manner that they can easily be converted into substantial warehouses and factory buildings.

THE LOWELL LECTURES

EIGHT courses of Lowell lectures on various subjects will begin in Boston on October 18 and will continue until April. Three of the lecturers are from England, one from France and four are from Harvard. The British visitors are Sir Frederick Whyte, K.C.S.I., LL.D., first president of the Indian legislative assembly; George Gilbert A. Murray, LL.D., D.Litt., F.B.A., regius professor of Greek in the University of Oxford, and George Peabody Gooch, M.A., D.Litt., well-known economist and publicist. The French visitor is Charles Diehl, member of the Institute of France and professor in the University of Paris. The Harvard lecturers are E. Leon Chaffee, M.A., Ph.D., professor of physics; William H. Weston, Jr., Ph.D., assistant professor of botany; Professor Roger Bigelow Merriman and Professor Archibald Davison.

The courses concerned with the sciences are as follows:

"Electric Waves"

By E. LEON CHAFFEE, M.A., Ph.D.

1.—Characteristics of Wave Motion Illustrated by Water Waves and Sound Waves. Electric Waves. The Electromagnetic Spectrum.

2.—Light. Types of Spectra. Absorption. Reflection. Color Phenomena.

3.—Infra-Red Light. Ultra-Violet Light. Fluorescence. Phosphorescence.

4.—Interference of Light Waves. Diffraction. Polarized Light.

5.—X-Rays. Cosmic Rays. Hertzian Waves.

6.—Radio Waves. Propagation of Radio Waves. Fading. Short Waves.

Mondays and Thursdays at eight o'clock in the evening, beginning Monday, January 3.

"Certain Diseases of Plants in Relation to Man's Affairs"

By WILLIAM H. WESTON, JR., Ph.D.

1.—The General Nature and Activities of Plant Diseases. Their Origin. Their Methods of Spread and the Growth of Our Knowledge and Control of Them.

2.—The Potato Blight, its Travels and Devastation in Their Relation to Famines and to Human Migrations.

3.—The Bud-rot of Palms, and Certain Scientific and Human Aspects of its Destructive Activities in the Orient and in the West Indies.

4.—The Oriental Downy-Mildews of Corn and Related Crops: Their Remarkable Nocturnal Activity, Their Probable Origin and the Problem of Preventing Them from reaching the Western Hemisphere.

5 and 6.—Certain Diseases of Sugar Cane and Their Influence on the Growth of the Sugar Industry and the Development of the Tropics.

Tuesdays and Fridays at eight o'clock in the evening, beginning Tuesday, January 13.

"Folk Songs of the British Isles"

By PROFESSOR ARCHIBALD DAVISON

Six lectures illustrated, additional announcement to be made later.

Mondays and Thursdays at eight o'clock in the evening, beginning Monday, April 4.

THE SYMPOSIUM ON CANCER CONTROL

As we go to press the symposium arranged by the American Society for the Control of Cancer is opening at Lake Mohonk, N. Y. The meeting is attended by a hundred specialists in the study of cancer, including sixteen of the leading authorities of Europe, who are guests of the association. The object of the symposium is an attempt to express in concise language the fundamental ground-work of fact and opinion upon which the collective effort now being made in the United States for the control of cancer should be continued and extended.

"The truth is that there are many things which physicians and surgeons can agree upon with reference to cancer, and if these agreements can be expressed in simple, concise and graphic language the results will be of incalculable value. They will be helpful not only to America but throughout the world."

Foreign specialists in attendance include:

Dr. Raffaele Bastianelli, Rome, professor of surgery at the University of Rome.

Dr. Leon Berard, Lyons, director of Anti-Cancer Center of Lyons, professor of surgery at the University of Lyons.

Dr. Robert Bierich, Hamburg, director of Institute for Cancer Control at Hamburg, lecturer on cancer research at Hamburg University.

Sir John Bland-Sutton, Bt., London, president of the Royal College of Surgeons, vice-chairman of the British Empire Cancer Campaign.

Professor Ferdinand Blumenthal, Berlin, director of Cancer Institute at Berlin, professor of Internal Medicine at the University of Berlin.

Professor H. T. Deelman, Groningen, director of the Institute of Pathology and Pathologic Anatomy at the University of Groningen.

Dr. William de Vries, Amsterdam, president of the Netherlands Cancer Institute, professor of pathologic anatomy, University of Amsterdam.

Dr. W. Sampson Handley, London, surgeon to the Middlesex Hospital.

Professor Henri Hartmann, Paris, professor of surgery at the University of Paris, director of Anti-Cancer Center at the Hotel Dieu.

Dr. Archibald Leitch, London, director Cancer Hospital Research Institute.

Professor J. Maisin, Louvain, director of the Institute and Center against Cancer at Louvain, professor at the University of Louvain.

Professor T. Marie, Toulouse, professor in the Medical College of the University of Toulouse, head of the Anti-Cancer Center at Toulouse.

Dr. James A. Murray, London, fellow Royal Society, director of Imperial Cancer Research Fund.

Dr. Claude Regaud, Paris, director Pasteur Laboratory of the Radium Institute.

Professor Gustav Roussy, Paris, director of the Laboratory of Pathologic Anatomy at the University of Paris, director of the Institute for Research and Treatment of Cancer at Villeguif (near Paris).

Dr. Albert Reverdin, Geneva, treasurer and general secretary of the Anti-Cancer Center of Geneva, member of Swiss Anti-Cancer League.

Among Americans who will take part in the meeting are Dr. Howard Canning Taylor, president; Dr. Francis Carter Wood, of New York, vice-president; Dr. Thomas M. Debevoise, secretary, and Dr. Soper, managing director of the society. According to plan, the meetings began on the evening of September 18 with an open session at which a number of popular addresses were made. All sessions were held in the large assembly hall of the Lake Mohonk House on the shore of Lake Mohonk.

Dr. Taylor, president of the society, opened the first formal session by delivering the annual address. Dr. Soper followed with an address on the purpose and plan of the meeting. This was followed by an address of welcome to the foreign guests by Professor William H. Welch, director of the School of Hygiene and Public Health of the Johns Hopkins University, in behalf of the American medical profession.

The reply in behalf of the foreign visitors was made by Sir John Bland-Sutton, Bart., of London.

The members of the conference started on Monday morning for Lake Mohonk from the Hotel Roosevelt and made the trip up the Hudson on a Hudson River Day Line steamer, stopping for lunch at Bear Mountain. From there the party proceeded by automobile to West Point and planned to return by way of Cornwall over the Storm King Highway to Mohonk.

SCIENTIFIC NOTES AND NEWS

THE National Academy of Sciences will hold its autumn meeting at the University of Pennsylvania and the Wistar Institute of Anatomy, Philadelphia, on November 8, 9 and 10.

THE Sixth International Congress of Philosophy held at Cambridge closed on September 16. The seventh congress will be held at Oxford in 1930, under the presidency of Professor J. A. Smith, of the University of Oxford. Lord Balfour and Lord Haldane were elected honorary presidents.

THE fifteenth award of the Willard Gibbs medal of the Chicago Section of the American Chemical Society was made on September 17 to Sir James Colquhoun Irvine, principal and vice-chancellor of the University of St. Andrews, in recognition of his contributions to the knowledge of carbohydrates; the medal has only twice before been awarded to a chemist from abroad, namely, to Dr. Svante Arrhenius and to Madame Curie.

CHARLES EDISON has succeeded his father, Thomas A. Edison, as president of all the Edison companies, which include the Edison Storage Battery Company, the Edison Phonograph Distributing Company, Thomas A. Edison, Inc., and other organizations comprising the Edison industries. Mr. Edison has become chairman of the board of directors.

SAMUEL INSULL, JR., was elected president of the Northern Indiana Public Service Company at a recent meeting of the board of directors. Samuel Insull at the same meeting resigned from the presidency and was elected chairman of the company. Mr. Insull, Jr., has also been elected president of the Midland Utilities Company, to succeed his father, who became chairman of the board.

A. ATWATER KENT, known for his work on radio development, has received from Worcester Polytechnic Institute the honorary degree of doctor of engineering.

DR. R. J. A. BERRY, professor of anatomy in the University of Melbourne, has accepted the Rockefeller Foundation's invitation to visit the United States and discuss the proposed establishment of a medical research institute in connection with the erection of the new Melbourne Hospital.

W. A. MOORE has left the University of Akron, where he served as professor of analytical chemistry for five years, to take up the work of research rubber chemist for the Watson Stabilator Co., Philadelphia, Pa.

M. M. AUSTIN has resigned his position as assistant professor in applied chemistry in the University of Illinois, to become research metallurgist with the Fansteel Products Co., Chicago, Ill.

DR. GEORGE P. MERRILL, head curator of geology in the National Museum under the Smithsonian Institution, has returned to Washington. After attending the Fourteenth International Geological Congress at Madrid, during which he visited the old quicksilver mines in Spain and spent ten days on the Island of Majorca, he made a tour of the principal museums of Europe. These included the museums at Madrid, Paris, Berne, Zurich, Vienna, Prague, Brussels and London.

DR. R. S. BASSLER, of the U. S. National Museum, who is spending several months abroad, writes to the museum as follows: "Monsieur Ferdinand Canu, of Versailles, France, has presented his entire collection of fossils, except the bryozoa which are duplicated in our collections, to the National Museum. This gift, consisting of 100,000 French fossils, is a noteworthy accession."

DR. FRANK E. E. GERMANN, professor of chemistry in the University of Colorado, after spending the past year on sabbatical leave, has returned to Boulder. He spent the year in research on the platino-cyanides under the auspices of the Carnegie Institution, in the physics and chemistry laboratories of Cornell University.

AN exchange of posts for the academic year 1926–27 has been effected between Dr. W. H. Pearsall, reader in botany in the University of Leeds, and Professor Otis F. Curtis, professor of plant physiology at Cornell University.

PROFESSOR BENJAMIN M. DUGGAR, of Washington University, St. Louis, has been made a member and chairman *pro tempore* of the board of trustees of the Bermuda Biological Station.

DR. DONALD H. MENZEL, instructor in astronomy in the Ohio State University, has been appointed to the position of assistant astronomer in the Lick Observatory.

CHAS. R. FETTKE and W. A. Copeland, of the Carnegie Institute of Technology, who have been making a detailed geological survey of the Bradford Quadrangle for the Pennsylvania Topographic and Geologic Survey, have returned to Pittsburgh. Field work will be continued next summer. That portion of the quadrangle included within the limits of the Bradford oil field is being mapped on a scale of 500 feet to the inch with structure contours on top of the Bradford sand at 5-foot intervals. The different methods of oil recovery at present employed and the results obtained are also being studied.

DR. EZRA ALLEN has been granted a year's leave of absence from Ursinus College. He has been appointed research associate of the Carnegie Institution of Washington and will work at Cold Spring Harbor on sex determination. He spent several weeks during the summer at the Institute of Anatomy, Liège, Belgium.

J. A. FERGUSON, head of the forestry instruction at Pennsylvania State College, has been granted leave of absence so that he may act as visiting professor of forest management at the Yale School of Forestry during the coming college year.

JAMES M. BELL, head of the department of chemistry of the University of North Carolina, has been granted leave of absence for one year and will spend the time in Europe.

FLORENCE M. FROST, director of the laboratories of The Polyclinic, Memphis, Tenn., has been granted a leave of absence and will spend the winter at the London School of Hygiene and Tropical Medicine.

DR. G. E. HARMON, of the department of hygiene and bacteriology of the School of Medicine of Western Reserve University, has returned to Cleveland after a year spent in research and study with Professor Karl Pearson at the Biometric Laboratory, University College, London.

PROFESSOR W. A. COGSHALL, head of the department of astronomy and director of the Kirkwood Observatory of Indiana University, spent the summer months in research at the Lowell Observatory, Flagstaff, Arizona. He was among other things especially occupied with photographic observations on the Milky Way.

PROFESSOR GEORGE H. SCOTT, for seven years dean of the Illinois College, was stricken with paralysis in the course of registration week and died on September 12. Before coming to Illinois College in 1919, Professor Scott served for some fifteen years as head of the department of mathematics of Yankton College, S. Dak.

DR. J. L. E. DREYER, of Oxford, director of the Armagh Observatory, Ireland, from 1882 to 1916, died on September 14, aged seventy-four years.

DR. RUDOLF CHRISTOPH EUCKEN, from 1874 until his retirement in 1920 professor of philosophy in the University of Jena, died on September 15, aged eighty years. Professor Eucken received the Nobel Prize in literature in 1908 and was exchange professor at Harvard University in 1912.

THE death at the age of fifty-seven years by disease contracted through research on X-rays is announced of Dr. Maxime Ménard, the French Röntgenologist.

DR. ERNEST LECHER, professor at the University of Vienna and a member of the Austrian committee of the International Electrotechnical Commission, died recently at the age of 70. Dr. Lecher was known for his many electrical experiments and particularly those in connection with the measurement of Hertzian waves.

ACCORDING to cablegrams to the daily press, Dr. Fritz Paneth and Dr. Peters, of the University of Berlin, have published an article in the current

issue of the journal of the German Chemical Society reporting the transformation of hydrogen into helium.

THE International Union of Pure and Applied Chemistry has adjourned its Washington meeting. The foreign delegates are visiting chemical centers in this country, including Wilmington, Pittsburgh, Schenectady and Niagara Falls, and were expected to reach New York City on September 23. The next meeting will be held in Poland by invitation of that government. At the 1927 conference German delegates will be admitted.

THE eighty members of the Cambridge University Medical Society, who have been visiting medical institutions in the United States and Canada, sailed for England on September 11.

A MEETING of the International Fisheries Commission—United States and Canada—was held in Victoria, British Columbia, on July 1, 1926. This meeting was attended by Henry O'Malley, commissioner of fisheries, and Miller Freeman, representing the United States, and John P. Babcock, representing Canada. W. A. Found, the other member for Canada, could not be present.

THE third meeting of Scandinavian chemists has recently been held in Helsingfors, Finland. Before the close of the meeting it was resolved to favor the early establishment of uniform and efficient legislation regarding the control of all sorts of food-stuffs in the Scandinavian countries. On the invitation of the Norwegian Chemical Society it was voted to hold the fourth chemists' meeting in Oslo, Norway, in 1932.

THE Optical Convention held recently at the Imperial College of Science, London, was the third of the kind; the previous meetings were in 1905 and 1912. The convention was opened by the prime minister, Mr. Stanley Baldwin. In his presidential address, the astronomer royal of Great Britain, Sir Frank Dyson, reviewed the progress of optical manufacture and remarked on the contribution of astronomers to the art of optical design. The ophthalmic section of the convention, in which alone there were more than thirty exhibits, was visited by more than 8,000 persons. About 100 technical papers were read at the meeting by leading British authorities in various branches of optics.

THE Department of Marine and Fisheries of Canada has begun to give its hatchery officers courses of scientific training through the agency of the Biological Board of Canada. Last month short courses of two weeks each were given in chemistry and physics, anatomy and physiology, fish diseases and fish foods. The lectures and demonstrations were held partly in Dalhousie University, Halifax, and partly at the Biological Station, Halifax, Canada.

FULL facilities of the George William Hooper Foundation for Medical Research, together with the use of its auxiliary department for the study of game diseases which may occur, has been proffered to the California Fish and Game Commission by Dr. K. F. Meyer, in charge of the foundation work in San Francisco.

AN expedition under the auspices of the New York Zoological Society and the Roosevelt Memorial Society to explore "The River of Doubt," which has since been named the Roosevelt River by the government of Brazil, will be undertaken by Robert Young Dyott, Eugene Bussey and Arthur Perkins, of New York.

A DIVISION for foreign and colonial affairs has been established in the institute for agriculture at the University of Frankfurt-on-Main, under the direction of Professor Otto Köbner, of Berlin.

WE learn from the American Medical Association that the provost of Indiana University stated in reply to an inquiry that during the ensuing eighteen months new construction and equipment at the Indiana University Medical Center in Indianapolis will include a $250,000 convalescent home contributed by the Rotary Clubs of Indiana; a $150,000 annex to the James Whitcomb Riley Hospital for Children, contributed by the Kiwanis Clubs of Indiana, and the construction and equipment of a $500,000 nurses' home and school, which sum was donated by the Ball Brothers of Muncie; the remainder of the $1,800,000 recently contributed to the hospital will be used to pay some indebtedness on the original construction and for an endowment fund; when completed, the Riley Hospital will have cost about $3,000,000. There is being constructed now the William H. Coleman Hospital for Women, which will cost $350,000; this sum was donated by William H. Coleman and wife, of Indianapolis. Next season, a $150,000 addition to the Indiana University School of Medicine will be constructed.

A HOSPITAL is being constructed at a cost of $225,000 for the Dartmouth Medical School. It is the gift of Mr. and Mrs. E. K. Hall, of New York, in memory of their son. The hospital will be known as "Dick Hall's House."

THE medical laboratory of the University of Iowa, which has been built at a cost of $800,000, will be ready for use in October.

THE Commonwealth Fund is making studies in eleven northern and mid-western states to determine the location of the third rural hospital to be constructed under the cooperative program initiated by the fund last February. The first institution is to be at Farmville, Va., where the contracts for its con-

struction have recently been let by Henry J. Southmayd, director of the fund's Division of Rural Hospitals. The second hospital unit will also be in the south, although its exact location has not as yet been chosen. In planning the third hospital, correspondence is being conducted with many cities and towns in the north and northwest. When applications are approved the fund will give two thirds of the cost of construction and equipment, while the community gives one third and the cost of upkeep. The Commonwealth Fund, of which Edward S. Harkness is president and Barry C. Smith general director, was chartered in 1918. In addition to her initial gift at that time, Mrs. Harkness made subsequent donations increasing the capital to $38,000,000. Child welfare and education work have been the main aims of the fund, which last year established twenty annual fellowships for British students in American universities.

Industrial and Engineering Chemistry states that in accordance with the regulations of the "van't Hoff Fund," founded June 28, 1913, the Royal Academy of Sciences which has supervision of the fund is preparing to give the annual grants to selected investigators in the field of pure and applied chemistry, who will have applied for such grants before November 1, 1926. The committee charged with considering the applications and awarding the grants consists of A. F. Holleman, president; F. M. Jaeger, A. Smits and J. P. Wibaut, secretary. This committee may appoint other members for one year only, to cooperate in judging the applications made. The names of persons to whom a grant is allowed will be published. The grantees are requested to send to the committee copies of papers relating to the results of their work, but they are at liberty to choose the manner of publication, as well as the journal in which they wish to publish their results, as long as they mention the fact that the research was made with an endowment from the "Van't Hoff Fund." The amount available for 1927 is about 1200 Dutch guilders. Applications should be sent by registered mail to Het Bestuur der Koninklijke Akademie van Wetenschappen, bestemd voor de Commissie van het "Van't Hoff-founds," Trippenhuis, Kloveniersburgwal, Amsterdam, with a detailed account of the proposed use of the grant, and of the reasons on which the candidates ground their claim. They must be received before November 1, 1927.

THE Hague correspondent of the London *Times* writes in regard to the experiments of Professor Keesom, of the University of Leyden, who has succeeded in solidifying helium, as follows: "Many attempts had been made before by Professor Kamerlingh Onnes. With the help of very strong pumps a temperature of less than nine-tenths of a degree above absolute zero was obtained, but at this temperature the helium remained in a liquid state. On June 25, however, by subjecting the helium to a pressure of 150 atmospheres and a temperature of 4¼ degrees absolute, the helium became fixed. A later experiment with 1½ degrees absolute and a pressure of 28 atmospheres was successful. The first experiment was accomplished in a steel tube, the second in a glass tube. The test of solidification was arranged in the following way: In the glass tube containing a few cubic centimeters of liquid helium, a piece of steel was placed. As long as the helium remained liquid, the steel could be moved by means of a magnet. As soon as the helium had become solidified the steel was frozen in and immovable."

UNIVERSITY AND EDUCATIONAL NOTES

AN agreement has been signed for the sale of the *West Australian* and its allied weekly, the *Western Mail*, to London investors. Perth University and the Anglican Church will benefit by three quarters and one quarter, respectively, of the proceeds, which are estimated at £600,000, under the terms of the will of the late owner, Mr. Hackett. The money must be used to build a memorial hall and an Anglican college, and to assist to maintain deserving university students.

C. R. HOOVER, senior professor of chemistry, has been elected vice-president of Wesleyan University, Middletown, Conn. G. Albert Hill is now acting as chairman of the department of chemistry.

DR. MERIT SCOTT, who for the past five years has been a member of the physics staff at Cornell University, has accepted the position of assistant professor of physics at Union College, Schenectady, N. Y.

AT Western Reserve University, Dr. George B. Ray has been promoted to an assistant professorship of physiology, and Dr. S. W. Chase to an assistant professorship of histology and embryology.

RALPH E. GRIM, graduate student in geology at Yale University, has been appointed assistant professor of geology at the University of Mississippi. He will also be assistant geologist on the Mississippi Geological Survey.

DR. R. J. RUSSELL, of the University of California, will go to Texas Technological College as associate professor of geology.

N. T. BOURKE, M.E. (Purdue), has gone from the University of Arkansas to the University of North Dakota as professor of mechanical engineering to succeed George B. Wharen, who died in May.

DR. ROGER C. SMITH, associate professor of entomology, and Dr. Ralph L. Parker, assistant professor

of entomology, at the Kansas State Agricultural College, have been promoted, respectively, to a professorship and associate professorship in the same institution. Dr. R. H. Painter, who recently received his doctorate from Ohio State University, has been appointed assistant professor. During the summer he was engaged in entomological work in Spanish Honduras.

DISCUSSION

HOOKE'S LAW

IT is distressing to observe the unwarranted reverence for Hooke's law so very generally shown by writers of text-books on physics for schools and colleges. This law dates back to 1676 and in the words "ut tensio sic vis" teaches the proportionality between stress and elastic strain. For example, an excellent English text-book, much used in our colleges and universities, states, "So long as the weight used to stretch the wire is not so great as to produce a permanent elongation of the wire, it is found that the elongation is proportional to the stretching force. This is known as Hooke's law." Two American text-books, intended for college use and published about a year ago, teach the same error. Still another American text-book, excellent and very widely used, devotes a third of a page to actual experimental data and states that the table "shows that the elongation is closely proportional to the stretching force." An inspection of these data, however, shows only a rough proportionality. A certain well-known scientific company is doing harm to young experimenters all over the country by publishing an elaborate instruction sheet which conveys the impression that accurate measurements should show strict proportionality between strain and stress. Moreover, I find that some of the writers in the *Philosophical Magazine* have the same mistaken impression.

In view of facts such as the above—and many more might be cited—I feel that a public service will be rendered if I exhume a prehistoric article of mine and make known the truth. This article was published in 1891 in Volume 44 of Wiedemann's Annalen under the title "Ueber das Gesetz der elastischen Dehnung" and a translation appeared in the January, 1892, number of the *American Journal of Science*. The wires investigated were of silver, copper, steel and brass, and they all *without a single exception* showed that the elastic lengthening increases more rapidly than the stretching force. The results with a brass wire are given below, but in order to show more strikingly the inaccuracy of Hooke's law I have made certain additions to the table as given in the published article.

BRASS WIRE

Mean of 20 series of measurements

Added wt. in grams	Lengthening in mm	Successive increments
200	7.111	7.111
400	14.272	7.161
600	21.488	7.216
800	28.770	7.282
1000	36.119	7.349
1200	43.554	7.435
1400	51.076	7.522
1600	58.679	7.603
1800	66.341	7.662

The elastic lengthenings x may be calculated from the added weights p in kg using the equation

$$x = 35.4385p + .5353p^2 + .1487p^3$$

and the discrepancy between observed and calculated values averages .0015 mm.

The probable error of the lengthening 43.554 mm was .0024 mm, and this is indicative of the accuracy of all the measurements. Thus it is clear from the above table that there is *without a single exception* an increase in the successive increments, and moreover the differences of the successive increments, .050 .055 .066 .067 .086 .087 .081 .059, indicate an increase nearly to the end. The diameter of the wire was .282 mm, the length 22700 mm and the initial load 665 grams.

To those curious to know the behavior of a wire unstrained by an initial load the following figures are interesting. Obviously a wire is strained somewhat by its own weight, and a small initial load is absolutely necessary in order to make the wire straight.

COPPER WIRE

Mean of 16 series of measurements

Added wt. in grams	Lengthening in mm	Successive increments
200	5.531	5.531
400	11.084	5.553
600	16.671	5.587
800	22.298	5.627
1000	27.949	5.651
1200	33.646	5.697

In the following measurements made with a copper wire of nearly the same length and diameter, the initial load (weight of pan, damper and half the weight of the wire) was only 192 grams.

Here again is an unbroken increase in the successive increments, and in their differences is an increase followed by a decrease.

If any one should repeat my work or extend it to other metals which I did not test I suggest that the following precautions be observed: Use wire coiled in large coils instead of wound on spools. If spool wire is used it should first be made smaller by a draw-plate and so straightened. Use fine wire, say .25 to .30 mm in diameter, so that after the cooling which necessarily ensues when a wire is stretched it may regain the air temperature before the lengthening is measured and before the elastic after-effect has a chance to appear. It was found that if the lengthenings were measured about twelve seconds after the application of the loads the measurements were not perceptibly vitiated either by the adiabatic cooling or by the elastic after-effect. Of course the wire should be long and one must always guard against error arising from changes in tower-temperature.

Since it is clear from the above that the ratio of stress to strain in a wire is a variable, it follows that the modulus of elasticity is also a variable, and so if we wish to speak of *the* modulus we should mean the modulus of the unstrained body. How to calculate this is shown in the original articles from which the above figures are taken.

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THE QUANTITATIVE THEORY OF SEX

THE quantitative theory of sex was first derived by the present writer in 1912 (preliminary note 1911), in essentially the same form as it stands today, from his experiments on intersexuality in the gipsy moth. (The term intersexuality was only used since 1915.) The theory claims that in both sexes determiners for femaleness and maleness are present, the relative quantities of which are balanced in such a way that one or the other has the upper hand in the respective sexes. Which of them is to be present in the higher quantity is decided by the mechanism of the sex-chromosomes, the meaning of which is thus explained, namely: one of the determiners (for maleness in the Abraxas type, for femaleness in the Drosophila type) is situated within the X-chromosome, the others (those for femaleness in the Abraxas type, for maleness in the Drosophila type) outside the X-chromosomes (in 1912 we assumed in the autosomes). Therefore, the always identical determiners for one sex are confronted either with one or with two doses of the determiners of the other sex. If the relative quantities of both are balanced in such a way that FF>M<MM (Abraxas type) and MM>F<FF (Drosophila type), normal sex-determination is explained on a quantitative basis: as a quantitative relation between male and female determiners, as I prefer to say, or a balance, as English writers prefer to call it. Intersexuality then appears, if the normal quantitative relation is changed in favor of the other sex in a definite way. When this theory was first derived in 1912 more than one sex-factor for each sex were assumed, namely, at least two for sex and secondary sex characters, and it was pointed out that each might really mean a group of linked factors. This notion has been abandoned since 1914, because the experiments show only the presence of one gene and therefore no necessity arose to split this into a group of linked genes. In 1912, further, the notion of the relative quantities was clearly indicated by the equations FF>M<MM. However, to fit these notions into the general genetical views the quantity of the genes was expressed in terms of their effect and called potencies or valencies. It was proved that M is inherited in the X-chromosome and it was assumed that F was inherited in an autosome. Later work, however, proved that in the gypsy moth F is inherited maternally (which is an experimental fact, not a theory) and it was made highly probable that this means inheritance in the Y-chromosome. Later, it was shown (and corroborated by Schweitzer and Lent) that in addition to the main factor for femaleness in the Y-chromosome there are at least two more factors for femaleness in the autosomes, the relation being a parallel to the main factor for spotting in rodents and its different modifiers. The last step was taken when (since 1917) the quantitative relation (balance) of the sex-differentiators could be linked with the embryological facts regarding intersexuality and thus the quantitative explanation of the mechanism of sex-determination could be enlarged into a physiological theory of sex-differentiation. The results of this analysis were published in a considerable number of papers since 1911, including a book (1920, also translated into English by Dakin) in which the quantitative theory was applied to the whole sex-problem and another book ("Die Quantitative Grundlage von Vererbung und Artbildung") in which the theory was developed into a general theory of heredity. I am glad to say that many zoologists and botanists have since accepted my theory as a solution of the sex problem and have assisted in their further development, thus creating quite an extensive literature about the subject. One of the most noteworthy among these contributions, which, however, had escaped the writer's notice, when publishing his book, was Standfuss's discovery of what nowadays is called triploid intersexuality (1908, 1914). Standfuss had shown a long time ago that sexual intergrades, at that time called gynandromorphs, were obtained in back-crosses from species-crosses in moths. After Federley's work on the chromosomes in such species-

crosses and the present writer's quantitative theory of sex were published he realized (1914) that both taken together give the explanation for these triploid intersexes: an abnormal balance of F and M as a consequence of the triploidy.

During the years between 1912 and 1922 the Columbia group of Drosophila workers was solidly opposed to my theory of sex. The different quotations of my work in their writings, among them a rather detailed review by Morgan and Bridges (1919) make it clear that they regarded facts and theory as something more or less queer which did not fit into their general views. Then Bridges (1922) rediscovered triploid intersexuality for Drosophila and was forced by the facts to accept every single point of importance of my quantitative theory. Bridges first realized that intersexuality as well as normal sex-determination can only be understood as a balance between female and male genes, as I had claimed since 1912. He further found that the female ones are situated in the X-chromosomes and the male ones outside, just as I had expected it for the Drosophila type since 1912. He further found that the male genes are situated in different autosomes. Here a difference between the gipsy moth and Drosophila appears; not a difference of theory but of fact. In Drosophila no factor in the Y-chromosome has yet been found and no principal genes for male sex (M), the others acting as modifiers as in Lymantria. This difference, however, might disappear with further work on Drosophila. Bridges prefers in his first paper to assume more than one gene for each sex, just as I had done in my first paper and prefers to call them + and − modifiers. In his later papers, however, he seems to get away more or less from this rather unfortunate notion and adopts further details from my theory, as the definite quantitative values, the epistatic minimum, etc. Of course there are differences in fact between triploid intersexuality in Drosophila and diploid intersexuality in the gipsy moth. In both the quantitative relation is regulated by the number of X-chromosomes. In the gipsy moth, however, where intersexuality occurs within the normal mechanism of the chromosomes, the decisive factor is the absolute quantity of the gene. Considering the other side of the equation in the triploid the abnormal quantities of male determiners (M) is produced by the presence of three sets of chromosomes instead of two, therefore three quantities of the respective genes instead of two. In diploid intersexuality, however, the number of such genes (here F) is always identical, only their absolute quantity being abnormal as a consequence of crossing races with different hereditary quantities of these genes. The method of breaking the normal balance of the sex-determiners is therefore different in both cases, the effect is the same and therefore the theory of sex determination derived from the facts is also the same.

It is rather unfortunate that Bridges omitted completely thus far to make a frank statement to the end that he has accepted now all the essentials of the present writer's theory of sex after ten years of opposition. Probably he intended to make such a statement in a forthcoming extensive paper and assumed meanwhile that the writer's work is sufficiently known to make such a statement unnecessary. During the last years, however, quite a number of papers have appeared (*e.g.*, by Sharp, Bonnevie, Bateson) in which the triploids of Drosophila have been hailed as opening a new insight into the sex problem. For the better information of such writers the present note is intended.

RICHARD GOLDSCHMIDT
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A NEW SPECIES OF MONILIA PATHOGENIC FOR MAN

A NEW species of monilia pathogenic for man has recently been identified by the writer. It was isolated from a case of clinical pulmonary tuberculosis. Small, hard, whitish granules were present in the sputum. It was from these granules that the organism was isolated. Tubercle bacilli were not found in the sputum nor did tuberculosis result from injection of the sputum into the peritoneal cavity of the guinea pig.

The organism grows abundantly on dextrose agar, the growth being creamy white with a smooth surface and composed of budding, yeast-like cells. In dextrose broth the organism develops both budding forms and mycelial threads, the latter of which are often long and branched. Asci are absent. Without preliminary acidification, milk is rendered alkaline, which is manifest in forty-eight hours. Acid and gas are produced in dextrose, levulose, maltose and galactose. Neither acid nor gas is present in saccharose, lactose, mannite, dulcite, raffinose, arabinose, adonite, dextrin, sorbite or inulin. Neither gelatin nor blood serum is liquefied. Indol is not produced. There is no pellicle formed on broth.

The organism was found to be pathogenic for rabbits and guinea pigs when injected intravenously, but not when injected intraperitoneally. It was pathogenic for white rats when injected intraperitoneally.

For means of identification the writer suggests the name Monilia richmondi for the organism described above.

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ROBERT MAYER

ON page 629 of SCIENCE Edward F. Adolph makes the statement that in later life Julius Robert Mayer's "mind gave way before the stupendous and intricate conceptions of the universe to which he was led" and that "he was taken to an insane asylum, but later recovered equilibrium, and spent the rest of his days in the simpler occupation of cultivating the vine." From all that we know, however, it seems safe to say that Mayer was not insane for one minute of his life. It is true that Mayer suffered by his failure to be recognized by his contemporaries and beginning with the day on which Poggendorf refused to print in his "Annalen" Mayer's original paper, most of the competent physicists and physiologists of his time held the opinion that Mayer was a crazy man. How else could he—as an outsider—stick so obstinately to conclusions condemned as insane by the authorities of the profession? From this atmosphere, sufficient reasons presented themselves to put Mayer in an asylum for the insane. One needs but read the correspondence of Mayer to become sufficiently impressed with the tragedy of this unjustified confinement, which rendered Mayer's life perhaps the hardest a great scientist ever had to endure.

WALTER LANDAUER
STORRS AGRICULTURAL EXPERIMENT STATION

QUOTATIONS

THE FUTURE OF AMERICA[1]

THESE two small books on a great subject are included in the "To-day and To-morrow" series, designed by the publishers to provide a stimulating survey of the most modern thought in many departments of life. Both are accordingly written in a critical and provocative style, compact with aphorisms. America's place in the world is assured and no resentment will be felt there at attempts to discover chinks in her formidable armour. Of the two books, Mr. Bretherton's is the longer and more careful study. Colonel Fuller's suggests the rapid travel impressions of a writer possessing a mature knowledge of world-history.

What is the basis for the strong and not altogether comfortable feeling that America is destined to exercise a powerful influence on the future of the world? The American, "the new white man," marches round the world with his war drum and the European falls in behind "with many a backward glance at the good old days." Nevertheless, the achievements of the United States in art, literature and science are unimportant in relation to their wealth and population. Jazz music and the skyscraper are "the only two new art forms" which Mr. Bretherton is prepared to concede to America as contributions to civilization. As to their education, the United States, he says, have countless universities but no educated class "outside of their college professors, who rank in the social scale a little higher than the average preacher, and a little lower than the average bootlegger." The matter can be tested by the output of books. "More books on natural history, botany and country life generally are published every year in England than have been published in the United States since the *Mayflower* landed there. The same is true of almost every other branch of literature outside of fiction."

As to forms of government, were we not given to understand that America wished to make the world safe from democracy? Mr. Bretherton produces no evidence of any genuine enthusiasm for democracy. Professional politicians, fanatics with a mania for inhibitions, bosses and spellbinders pullulate. The American reacts by forming the habit of acting, thinking, living and believing "by numbers." Prohibition, it is well known, does not prevent an American from getting a drink. But this necessitates a mental process. "He will in the end decide that it is simpler (and more profitable) to stay dry and reserve his mental processes for money-making." So with fundamentalism. The vast majority of American people, Mr. Bretherton asserts, are reconciled to evolution and have no quarrel with science, which scatters machines and fertilizers with a fatherly hand. Fundamentalism will "win through" because big business will decide that the man-machine who pauses intermittently from wielding his shovel to ask himself unanswerable questions about the macrocosm is a shade less efficient—say by one ten per cent.—than if he accepted "the Bible as written." "The most striking thing about the young Americans of to-day," says Mr. Bretherton, "is that they know nothing and have no ideas of their own." They are forgetting how to think. Like goldfish, they chase feverishly round a glass globe, seeming in some mysterious way to be unaware of one dimension. Their industry is amazing, whether in money-making or in ticking off the sights of Europe in Baedeker.

Significantly, neither author attempts a chapter on American humor, perhaps because it would have resembled the famous chapter on snakes in Ireland. The discussion of the American woman seems inadequate to the importance of the subject. Mr. Bretherton regrets her limited output of poetry, fiction and

[1] *Midas: or, The United States and the Future.* By C. H. Bretherton. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co., 1926.) 2*s.* 6*d.* net.

Atlantis: America and the Future. By Colonel J. F. C. Fuller. (To-day and To-morrow Series.) Pp. 96. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co.; n.d.) 2*s.* 6*d.* net.

ephemeral literature. Colonel Fuller is captivated by her charms, contrasting her favorably with her brothers, who appeared to him "gross, ill-mannered, and in their straw hats and trouser belts more or less offensive to the eye."

The question obtrudes—How will it all end? It would be unfair to the authors to reveal their conclusions. Both recognize that something will happen some day when America is disillusioned about the power of money and the booster's curve approaches horizontally, its tangent vanishing like the Cheshire cat. The fate of Rome is not reserved for America, for the simple reason that there are no barbarians to rush in and submerge the American counting house and lobster palace "in one red burial blent." Authors who attempt to foretell the future of America in a hundred years are on safer ground than men of science who predict the position of an unknown planet or the properties of an undiscovered element. Their work should be encouraged, for the national tendencies which they explore have their bearing on our daily life. Possibly the jazz music wafted across the Atlantic sounds a clarion bugle-call if we would listen and interpret.—Review in *Nature* signed T. Ll. H.

SCIENTIFIC BOOKS

A Pioneer in Public Health—William Thompson Sedgwick. Yale University Press, 1924. $2.00.

FROM his temple, the laboratory, Sedgwick the lover of mankind looked upon communities with the clinical sense of a physician, studied their factors of disability with the precision of the biologist, planned like an engineer for the specific remedies required, and with statesmanship undertook to influence a nation by the education of wise and courageous leaders in the science and art of safe and happy congregate existence.

If the authors of this tribute to a master have not all in equal degree repeated and extended the accomplishments of their teacher, colleague and friend, it would be difficult to find three men in this country in whose lives and work the ambitions, the services, the ideals of Professor Sedgwick have been more nearly duplicated. The names of Whipple, Jordan and Winslow are, as it were, parts of the great educational and inspirational entity which it symbolized for students of public health in the name of Sedgwick.

Rarely is there revealed in the story of men who play large rôles in public affairs that precious, intelligent, loyal and wholly sympathetic sharing in work and plans by the wife which was so beautiful and essential in the Sedgwick home. Mrs. Sedgwick shared abundantly in that "larger perception of what a fundamental scientific philosophy of life may mean to the individual and to the community of which he forms a part."

The authors lead us quickly into the threshold of the story, with no delay for juvenalia. We follow the eager and exulting progress through Yale and Johns Hopkins. How adequate and fortunate is the epitome of the first twenty-eight years of this Sir Galahad of sanitation.

Sedgwick found his career as a biologist and a teacher in 1880. He won his wife in 1881. A call to the Massachusetts Institute of Technology, the institution to which he and Mrs. Sedgwick devoted their lives with rare ardor, came in 1883. The stage was set and the actors were prepared, for the development of a new and beneficent influence of science upon the life of men.

We see among scientists and perhaps most strikingly among the biologists and with particular distinction in those who undertook to lead in the unknown world of bacteriology, the earliest break from the formal self-satisfaction of the Victorian era.

To accept all disease and premature death as a natural fate due to quite impersonal environmental causes, predetermined and unquestioned, became an inconceivable philosophy to those who shared in the discovery of the biological relations of man to his fellow men *via* the ubiquitous bacterium. Persons not premises, beings not things, functions not forms became the obvious answer of science to the do-nothingism of the sixties and seventies in public health.

Sedgwick through critical studies, by education to an ever-widening audience, through book, lecture, article, personal conference, by public leadership and action, persistent and resistless, carried a great body of opinion through the sterile era of sanitation by enforcement, by law, by authority, to the period of general popular understanding of the biological basis of human relationships and on into the application of conscious individual and community hygiene.

No important or stirring episode of Sedgwick's progress from laboratory to locality, from local power to national influence, from national authority to international recognition is omitted, and the reader closes the chapters with a feeling of content that there was such a life history, completed and successful, honorable and honored, to confuse the cynics and embarrass the pessimists. His publications in themselves as listed through the forty-three years of enthusiastic and joyful labor will for a long time serve as a safe record for future health historians, who must condense the accomplishments of a generation into a brief chapter of some yet unpublished history of our times.

How widely the communities, the sciences, the educational institutions of this country are still his debtors is to be found by those who read the list of Sedgwick's "boys," a fine quiver full of crusaders devoted in their various ways to passing on the three gifts which we know he bestowed upon his pupils—"a vision of the subject in hand in its relation to the revolving universe, a rigorously honest method of thinking and working so that the truth may be adhered to and if possible advanced, and an enthusiasm for service which will prove better even than the desire for fame as the compelling motive to make men 'scorn delights and live laboriously.'"

HAVEN EMERSON

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A FOCUSSING X-RAY SPECTROGRAPH FOR LOW TEMPERATURES

FOR the investigation of crystal structure at low temperatures, especially when liquid hydrogen or liquid helium is used, it is essential to make the time of exposure as short as possible. To do this by the ordinary powder method a small camera is used, which naturally decreases the accuracy of measurement. Moreover, certain corrections have to be made to account for the width of the lines (*e.g.*, thickness of the specimen, absorption in the substance, etc.).

It is possible to overcome these difficulties by using the focussing principle by Seeman and Bohlin.[1] By this method the time of exposure is very considerably shortened and the dispersion increased. Since one edge of the lines always remains sharp, none of the above corrections need be made. The essential point of this method is that slit, crystal layer and film are arranged on the circumference of the same circle and a divergent beam illuminates a broad sheet of crystals. Each ray, which fulfills the diffraction equation $n\lambda = 2d \sin \theta$ for any particular crystal plane, is then focussed at the same point on the film.

An experimental arrangement using this principle at liquid air and liquid hydrogen temperatures is shown in Fig. 1.

A divergent beam of X-rays enters through a wedge-shaped lead slit L S in the brass cylinder, which forms the wall of the camera and strikes a crystal layer deposited on the bottom of a Dewar flask (made of Pyrex glass or metal) D, which fits with a ground joint into the camera. The bottom of the Dewar flask D is ground to the same cylindrical

[1] H. Seeman, Ann. d. Physik, 59, 455 (1919); H. Bohlin, *ibid.*, 61, 421 (1920).

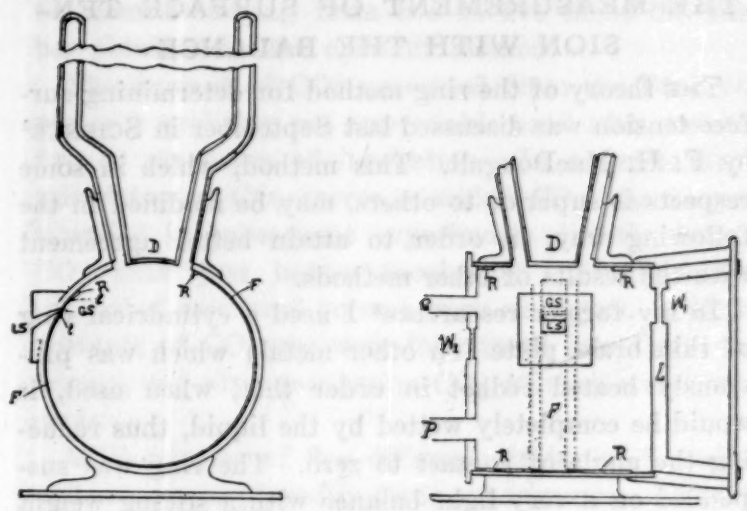

FIG. 1

curvature as the wall of the camera. The film F is pressed to the wall of the camera by a ring R. The brass ring R, which fits snugly into the brass cylinder of the camera, has a slot 1 cm wide for the exposure of the film. On the same ring a gold slit G S, 0.04 mm wide, with precisely ground edges, is mounted coincident with the inner edge of the lead slit L S. The gold slit G S is placed on the same circumference as the exposed side of the film. Both sides of the gold slit G S are screened with lead (1) to avoid scattering from the slit.

The open end of the camera is closed by a lid L and the lead slit L S is made vacuum tight with aluminium foil, .05 mm thick. The entire camera is evacuated through the tube P, and gas can be admitted through the tube G. The formation of crystals can be controlled by observation through a glass window in the lid W1 and illumination of the crystalline deposit secured through the window W2.

Our experiments have shown that the theoretical expectations are fulfilled. With a Shearer tube (copper or iron target), intense and sharp patterns could be obtained in 300 to 600 milliampere minutes varying with the material investigated and according to the filters with which the film was covered.

Chlorine and bromine have been investigated. The results will be published elsewhere. Investigations of other substances are now being conducted.

Thanks are due to the International Education Board, who made the investigation possible through a travelling fellowship and the necessary financial assistance for the construction of the apparatuses used, and to the department of physics of the University of Toronto for the use of laboratory facilities.

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THE MEASUREMENT OF SURFACE TENSION WITH THE BALANCE

THE theory of the ring method for determining surface tension was discussed last September in SCIENCE[1] by F. H. MacDougall. This method, which in some respects is superior to others, may be modified in the following way, in order to attain better agreement with the results of other methods.

In my former researches[2] I used a cylindrical ring of thin brass plate (on other metal) which was previously heated redhot in order that, when used, it would be completely wetted by the liquid, thus reducing the angle of contact to zero. The ring was suspended on a very light balance with a sliding weight and no doubt may as well be combined with the tensiometer of duNoüy; without the sliding weight the balance must be in the zero position with the wetted ring.

Then the balance is lowered slowly, till the ring touches the surface of the liquid and is pulled down into it by the surface tension. Then the sliding weight is put on the longer arm and shifted along the same till the pointer stands exactly on the same mark (zero) as at the moment when the ring first touched the surface, the under edge of the ring thus being lifted just to the level of the liquid. The pull measured at that height—the level weight—is $p = 4r\pi\alpha$, or if the ring be not infinitely thin and r', r'' are the inner and outer radius,

$$p = 2\pi(r' + r'')\alpha$$

being always smaller than the pull at the instant of rupture—the separating weight.

Thus I got for water at 20° C $\alpha = 74.85$ dynes per centimeter, a value differing but little from many obtained by other methods, for instance, by Grunmach[3] and Kolowrat-Tscherwinski[4] using the method of ripples. With other liquids than water and with watery solutions the angle of contact S with a metal ring can not always be made zero and must then be determined in each case. The following formula should then be used.

$$p = 2\pi(r' + r'') \propto \cos S$$

If the properties of anomalous water surfaces[5] be under investigation, when the tension varies with size and time, the balance method is the sole one applicable. But in that case a cylindrical ring can not be used, first because the measurement must be made in very short time and the above course is not fast enough; secondly, because the tension of the surface enclosed by the ring would not be the same as on the outer surface.

Therefore I used in most of my investigations an auxiliary balance with a very small platinum ring, 6 mm in diameter, which acts like a disk taking the enclosed water surface with it in breaking off. The separating weight was read and afterwards transformed into the corresponding surface tension by the aid of an empirically established table.

AGNES POCKELS

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THE DETERMINATION OF VIABLE LACTOBACILLUS ACIDOPHILUS[1]

CONSIDERABLE difficulty has been experienced recently in this laboratory in the quantitative determination of viable L. acidophilus in cultures containing certain strains of this species.

It has been the custom in the laboratory for the past five years to use the casein-digest, skim milk digest, galactose agar described by Kulp and Rettger[2] (1924) for the routine plating of acidophilus milk. The milk sample and dilutions are shaken fifty times, in the manner recommended in the Standard Methods of Milk Analysis[3] (1923). The agar plates are incubated at 37° C. for forty-eight hours and the colonies counted with the aid of a 4× hand lens. Type of colony is determined by observation with the low power of the microscope.

It developed that acidophilus milk prepared with a certain strain (Scav.), which had never given a very high count by this method, without any apparent reason began to give L. acidophilus counts which were alarmingly low. New materials had been employed in the preparation of the casein-digest plating medium, and therefore it was thought that some of these new ingredients were exercising an inhibitory effect upon the bacteria. Five other strains were plated with this same medium. Three of these strains grew very well, while two did not. This was sufficient evidence to indicate that the ingredients were not at fault.

Comparative platings of the six strains were made in the routine medium and in whey agar containing one per cent. galactose and prepared according to the method of Rettger and Cheplin[4] (1921). All strains gave higher counts in the whey agar than in

[1] The author wishes to express gratitude to Prof. L. F. Rettger for his kindness in criticizing and correcting this manuscript.

[1] MacDougall, SCIENCE, 62, 1604, p. 290.

[2] A. Pockels, Wied. Ann., 67, p. 668 (1899).

[3] *Ann. d. Phys.*, 9, 1283 (1902).

[4] Journ. d. Russ. Phys. Chem. Ges., 36, 265 (1904).

[5] A. Pockels, *Nature*, 43, p. 437, 1891; 46, p. 418, 1892; 48, p. 152, 1893; *Ann. d. Phys.*, 8, p. 855, 1902.

[2] Kulp, W. L., and Rettger, L. F., 1924, "A Comparative Study of L. acidophilus and L. bulgaricus." *Jour. Bact. 9*, 357–394.

[3] Standard Methods for Milk Analysis (1923).

[4] Rettger, L. F., and Cheplin, H. A., 1921, "The Transformation of the Intestinal Flora, with Special Reference to the Implantation of Bacillus Acidophilus," Yale University Press.

the routine medium. However, three strains continued to give lower counts than it was thought they should.

Valley and Rettger[5] (1926) have shown that carbon dioxide is necessary for bacterial development, and that while many bacterial species will grow and multiply normally in the presence of the ordinary atmospheric CO_2 (about 0.03 per cent.), others are accelerated in their growth when they are provided with an atmosphere containing from 1 to 10 per cent. or even more CO_2 gas. L. acidophilus was found to belong to the latter group.

They showed more recently[6] that added CO_2 in the gaseous environment is responsible for much larger plate counts of L. acidophilus and for the development of larger, and more typical colonies. The degree to which added CO_2 favored development varied with the different strains of the organism.

An application of this principle in the plating out of the more backward strains of L. acidophilus was regarded as a possible way out of the present dilemma. Accordingly, whey agar platings were made from one of the "low count" strains. The plates were placed in a can with two dextrose agar plates freshly inoculated with Bact. coli. The Bact. coli growth was expected to increase the CO_2 content of the can, which was closed with a fairly tight-fitting cap. These plates, together with a set of open-air whey agar control plates of L. acidophilus, were incubated at 37° C. for forty-eight hours. The results of this preliminary experiment are given in Table I.

TABLE I[7]

COLONIES PER CUBIC CENTIMETER OF MILK PLATED IN WHEY GALACTOSE AGAR

In closed can with Bact. coli.	In open can; no Bact. coli.
280 M	190 M
600 M	250 M
680 M	Few
100 M	50 M
260 M	51 M
900 M	450 M
100 M	45 M
160 M	90 M

M – Millions.

The superiority of the method involving the use of the closed tin and Bact. coli plates is very apparent, the counts ranging from two to five times the number obtained by the open-air method.

The amount of CO^2 generated from the Bact. coli plates is probably not appreciable until after the first five or six hours of incubation. In order to avoid this delay in CO_2 increase, added CO_2 was in part supplied in subsequent experiments directly from a CO_2 tank just before incubation. Air-tight containers of measured volume were employed. Definite amounts of CO_2 gas were introduced into these containers, and after incubation CO_2 determinations were made.

Milk cultures of five different strains of L. acidophilus were employed in these experiments. Five sets of dilution plates were made from each milk culture, with whey-galactose agar as the plating medium. The agar plates were arranged for incubation as follows:

Set No. 1—Plates in open can.
Set No. 2—Closed can (not air-tight) with Bact. coli plates.
Set No. 3—Plates in air-tight jar with 5 per cent CO_2.
Set No. 4— " " " " " 10 per cent CO_2.
Set No. 5— " " " " " Bact. coli plates.

The results of a typical comparative experiment are given in Table II.

TABLE II.

L. ACIDOPHILUS PER CUBIC CENTIMETER OF MILK

Strain	Set No. 1	Set No. 2	Set No. 3	Set No. 4	Set No. 5
R–1–1	430 M	620 M	760 M	620 M	680 M
Ala.	N. C.	N. C.	25 M	45 M	30 M
Cas.	N. C.	N. C.	160 M	235 M	50 M
Scav.	N. C.	300 T	190 M	160 M	64 M
4 B	14 M	38 M	50 M	46 M	30 M
Residual CO_2	——	——	5 %	9%	2%

M–Millions; T–Thousands; N. C.–No colonies on plates.

These results require very little comment. Carbon dioxide in amounts varying between one and ten per cent. of the total gas in the container causes an increase in the growth of L. acidophilus. Some strains are more susceptible to the CO_2 than others. Strains R–1–1 and 4 B are rat strains; the source of "Ala" is unknown, while "Cas" and "Scav" are of human origin. According to these experiments, the human strains are apparently more dependent upon CO_2 for growth in agar plates than the rat strains. However, insufficient data are at hand to warrant a final statement to this effect. The plates exposed to CO_2 in amount varying from 5 to 10 per cent. of the container volume yielded the highest counts of L. acidophilus.

Based upon the results of the foregoing experiments, the following procedure for the quantitative

[5] Valley, George, and Rettger, L. F., 1926, "Carbon Dioxide Requirements of Bacteria," *Jour. Bact., 11,* 78–79.

[6] Report in preparation and as yet unpublished.

[7] The writer is grateful to his wife for the determination of the bacterial counts employed in this table.

determination of viable L. acidophilus in acidophilus milk and other cultures seems warranted at this time.

The medium recommended here is whey-peptone-galactose agar.

Whey is made by the method advocated by Rettger and Cheplin[8] (1921), which is essentially as follows: Skimmed milk is heated to 85–90° C. The amount of 10 per cent. HCl necessary to precipitate the casein in 10 cc amounts of the hot milk is determined. From this the volume of acid required to precipitate the casein in the entire volume of milk is calculated. The whey is removed from the precipitated casein by filtration through three or four thicknesses of cheesecloth. The filtrate is adjusted to a reaction of pH 6.8 with 10 per cent. NaOH and placed in flasks. The cotton-plugged flasks are autoclaved at fifteen pounds extra steam pressure for twenty minutes. The lactalbumen is completely coagulated and after this precipitate has settled to the bottom of the flask, the supernatant whey is decanted off and filtered. It is the custom in this laboratory to employ one and one half liter flasks and to fill them only two thirds full to avoid boiling over, on sudden cooling after autoclaving. Whey prepared in this manner can be used when needed.

The method for the preparation of agar is as follows. To 1000 cc of whey add 5 grams peptone. Adjust reaction to pH 6.5. Add 10 grams Difco granular agar and autoclave to dissolve the agar. Add 10 grams galactose and filter through absorbent cotton.

The milk sample and all dilutions are treated as stated in the first part of this paper.

Carbon dioxide gas amounting to from 5 to 10 per cent. of the container volume is added immediately before incubation.

A satisfactory and readily available container is the Kodak Developing Tank made by the Eastman Kodak Company and sold by their agents in all parts of the country. The tank should be about five inches in diameter and eight inches high, the one used in developing five by seven films. The accompanying cut[8] with appended note illustrates the set-up for L. acidophilus work.

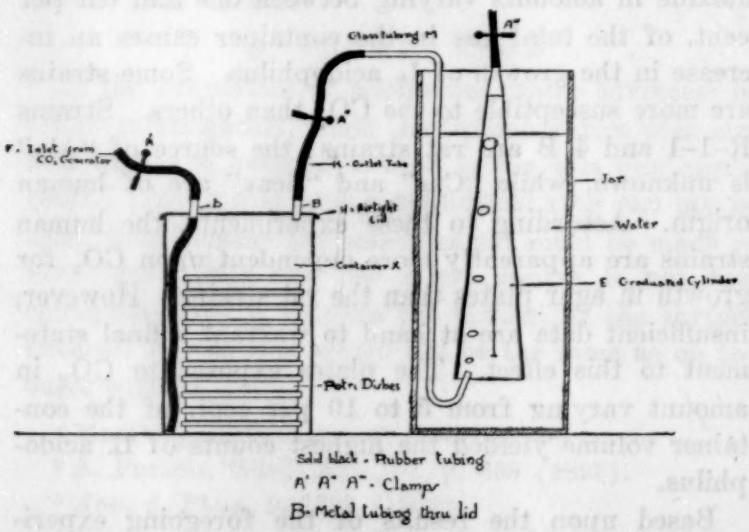

FIG. 1

EXPLANATION OF FIGURE 1

The agar plates are placed in the container X and the lid H screwed on tightly. The inlet tube F is connected with a CO_2 generator and the outlet tube K with the glass tubing M, the open end of which is placed in the mouth of the inverted graduated conical cylinder E. A Sedgwick-Rafter funnel is employed, but any large bruette or graduated cylinder will serve the purpose. The jar holding the inverted cylinder is filled with water.

The volume of the container X must be known. By subtracting from the total volume of the can 40 to 50 cc for each agar plate the approximate volume of the container is obtained. The clamps A′ and A″ are opened and CO_2 allowed to enter the container through F, forcing a corresponding amount of the contained air through K. The volume of displaced water in E is a direct measure of the expelled air. A volume of CO_2 equal to from 5 to 10 per cent. of the total atmospheric volume of X should be displaced. A′ and A″ are then tightly closed and the rubber tubing disconnected from the CO_2 generator and the gasometer jar. The apparatus is now ready for incubation.

Methods of incubation and counting have already been described briefly.

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SPECIAL ARTICLES

THEORIES OF A NEW SOLID JUNCTION RECTIFIER

AT the Physical Society meeting held at Washington on April 23 and 24, this year, the writer described a new type of electronic rectifier. The rectifier unit consists of a disc of copper having an oxide formed on its surface. It is found that, under suitable conditions, current flows more readily from the oxide to the copper than in the reverse direction, the phenomenon being very much like that observed in a high-vacuum electronic-discharge tube, in which electrons flow more readily from the hot cathode to the anode than from the anode to the cathode. The new rectifier acts as if a minute electronic cell existed at the junction between the copper and the oxide.

The rectifier operates with quite large current den-

[8] The writer is indebted to Mr. George Hunt for this drawing.

sities and ratios between high resistance and low resistance as great as 20,000 to 1 have been obtained.

The structure of this new rectifier is radically different from that of other similar rectifiers that have been developed in the past. The seat of rectification is apparently restricted to the layer near the junction between the copper and the compound formed on it, and the explanations of contact rectification that appear most prominently in the literature are untenable in regard to this rectifier. These explanations are based, most frequently, on either electrolysis or thermo-electricity.

The solids that rectify electrolytically require some time to come to their steady state and deteriorate rather rapidly. The rectified currents are unsteady and full of abrupt changes. The products of electrolysis soon appear at the boundary and even throughout the body of the compound. The present rectifier has none of these characteristics. It responds immediately and does not show any signs of either chemical or physical change even after long continuous operation at the proper operating temperatures. The current is steady and indicates a definite resistance at each value of the voltage. The action is, therefore, not electrolytic.

The layer of compound used in the new rectifier may be as low as 0.025 mm in thickness. This in itself makes it seem rather unlikely that the effect is thermoelectric, since it would be difficult to maintain any appreciable temperature difference between two surfaces that are so near one another. The fact that the thermo-electromotive force that may be assumed is in the wrong direction makes the theory entirely untenable.

Jolley in his book on "Alternating Current Rectification" mentions a theory which assumes a double layer, each half of which is made up of one constituent of the crystal. This condition may exist in the present instance at the surface where the two substances are joined to each other. It may be that below the last layer that contains oxygen atoms there is a layer of copper atoms all or most of which are in chemical combination with the oxygen. It is not easy to get a mental picture of the action of such a double layer, but the idea may have value when taken together with work function considerations.

Many observations indicate that the essential characteristic of this rectifier is the very intimate relationship that exists between the metal and the oxide and that the rectification takes place at the junction where the copper and the oxide may be thought of as being each within the sphere of influence of the other. Schottky[1] shows how it is possible to make some cases of unidirectional conductivity seem plausible on such considerations. In the present case, however, it seems likely that copper has a greater work function and also that its work function involves a steeper potential gradient than does that of copper oxide. It is difficult to see on this basis why it should be easier by means of an externally applied electromotive force to make electrons pass from the copper into the oxide than the reverse. It seems likely that Schottky's theory of contact rectification does not give the full explanation of the present phenomenon.

I wish to make a very tentative suggestion of another theory which goes one step farther than the suggestions made by Schottky. Schottky assumes that an electron has to move up through one potential gradient and down through the other. If the two substances form one continuous body, an electron in passing from one to the other may have to move through a potential difference corresponding to only the difference between the electron affinities of the two materials. If the electron affinities of copper and of copper oxide are nearly the same and the two materials are in such relationship as to really constitute a single body we may then have a condition in which only a small amount of energy is necessary to enable an electron to escape from one substance and into the other. If we think of copper as having a great number of free electrons this may result in an enormous emission of electrons from the copper into the oxide even at room temperatures. Under this condition the copper serves the same purpose as the hot wire filament in a vacuum tube and maintains an atmosphere of electrons in the oxide in excess of the normal amount.

The evaporation of electrons from the copper into the oxide proceeds until an equilibrium is established between what we might call either the vapor tension or the diffusion pressure of the electrons in the copper and the electrostatic forces that are set up by the excess electrons in the copper oxide, similar to the electron equilibrium that exists at the surface of a hot filament.

If an external potential difference is applied between the copper and the contact on the free surface of the oxide a current will flow, and if the potential difference is very small the current is approximately the same, independent of the direction of the applied e.m.f. This is to be expected because the equilibrium is only slightly disturbed and the electrons may move with equal facility in either direction. When the potential difference is increased, a new condition of equilibrium is set up, depending on the direction of the electromotive force. If the e.m.f.

[1] W. Schottky, *Zeits. für Physik*, 14, p. 63, March, 1923.

is in such a direction as to force the electrons from the copper into the copper oxide, some of the electrons in the copper oxide are removed and the diffusion pressure of the electrons in the copper is then in such direction as to help the flow of the current. The electron current, therefore, flows freely from the copper to the oxide. The minute spacing between the electrodes, the comparatively large areas and possibly the dielectric constant of the copper oxide all contribute to make the impedance in this direction low.

When the applied potential difference is reversed so that the electrons are driven back into the copper, another condition of equilibrium is established in which the diffusion of the highest speed electrons against the applied potential difference maintains a smaller number of excess electrons in the copper oxide. These electrons occupy a thin layer very close to the junction between the copper and the copper oxide so that in the high resistance direction the whole potential gradient is concentrated in this thin layer. This agrees with the experimental fact that in the high resistance direction the potential drop is all at or very near the junction between the two materials. It is probably also in agreement with the fact that the high resistance decreases rapidly with rise in temperature, since at higher temperatures the conductivity of the oxide increases and this may correspond to a greater number of free electrons and a smaller difference between the free electron concentrations in the oxide and the copper.

The above is admittedly only the skeleton of a theory, but it seems to be consistent with the voltage and the temperature characteristics of the junction rectifier.

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EXPERIMENTAL MODIFICATION OF POLARITY IN MARINE OVA

IN their experimental studies on ova of the sea urchin *Lytechinus variegatus*, Taylor and Tennent (1924)[1] found that each half of an unfertilized ovum which had been bisected by the micromanipulation method either through the poles or through the equator would, upon subsequent fertilization, divide in both first and second cleavages at right angles to the plane of section.

These results suggested to us a similar problem on ova of the starfish *Patiria miniata* which abounds along the shore of Monterey Bay near the Hopkins Marine Station of Stanford University. This species is actively spawning during the months of April and May, when our experiments were performed. Several animals were brought into the laboratory each morning and placed upon clean glass plates. Usually within an hour or so sperm or eggs (fully matured) were freely extruding through the gonopores. These were carefully pipetted into thoroughly clean finger bowls containing fresh sea water. The eggs were well washed with one or two changes of sea water before the experiments were begun.

The polarity of the beautifully clear, matured ova of *Patiria miniata* can readily be recognized by the position of the conspicuous polar bodies. The first and second cleavage planes normally intersect at right angles near the polar bodies. In about sixteen hours after cleavage begins, that side of the blastula diametrically opposite the polar bodies shows a distinct thickening. This thickening represents the vegetal pole where invagination occurs some twenty-eight hours after fertilization.

The merotomy experiments were performed with the aid of quartz micro-needles which were operated in a moist chamber by means of a Taylor micromanipulator. Upon placing from one to several ova on a coverslip which had been scrupulously cleaned by the aqua regia-alcohol method (Taylor, 1920),[2] a suitable amount of the water was drawn off just sufficient to slightly compress the ova and thus hold them nicely in position for cutting.

More than eight hundred ova of this species *P. miniata* have thus been operated upon. These were bisected through various planes—some through the poles, others through the equator and still others (the majority) through planes making practically all angles with the polar axis.

The two fragments thus resulting were thereupon transferred by means of a mouth pipette to fresh sea water contained in inch size watch glasses, to which a drop of light sperm suspension was, a few minutes later, added. Fertilization membranes appeared usually, within three to five minutes after insemination. After three or four hours the fragments were transferred to fresh sea water. Careful observations were made on each fertilized fragment. Full notes were recorded on 653 fragments.

The results of our experiments appear to be conclusive in demonstrating that without exception the first and second cleavage planes passed through the fragment at right angles to the plane of section.

Immediately upon transection, the two fragments tend to be elongated parallel to the plane of cutting—

[1] Taylor, C. V., and Tennent, D. H., "Development of Egg Fragments," Carnegie Institution Year Book, No. 23, pp. 201–206, 1924.

[2] Taylor, C. V., "An Accurately Controllable Micropipette," SCIENCE, n. s., 51, 617–618.

although within a few minutes they may assume a nearly rounded or quite rounded form. Accordingly, we at first thought that our consistent results might be interpreted in terms of the Hertwig hypothesis that the cleavage spindle tends to orient itself with its long axis parallel to the long axis of the egg (or fragment). We then devised means of testing this hypothesis. Matured but unfertilized ova were siphoned by capillarity through a thoroughly clean glass capillary, of size precisely adequate to induce an elongation of the ova about one and one half times their normal diameter. These elongated ova, upon passing out of the capillary into fresh sea water, retained quite conspicuously a longer axis, even though their resilience tended to bring back their former roundness.

With rare exceptions several dozen ova thus elongated readily formed, upon insemination, clear, full-sized fertilization membranes. The first and second cleavages which ensued without noticeable delay occurred in planes intersecting near the polar bodies, precisely as in the controls, irrespective of the induced longer axis.

We further demonstrated that fragments which were allowed to round up before insemination cleaved likewise at right angles to the plane of section.

In about fifty-three recorded cases of merotomized ova of the two sea urchins *Strongylocentrotus purpuratus* and *S. franciscanus*, we have more recently obtained results which agree with those recorded above for the ova of the starfish *P. miniata*.

Our results, therefore, tend to substantiate the findings of Taylor and Tennent (1924) in similar experiments on the ova of *Lytechinus variegatus*.

Our experiments go further, however, in showing that the planes of the first two cleavages are at right angles to the cut surface of the fragments, whether the plane of section passes through the poles, through the equator or *through any other plane of the ovum*. Furthermore, this rule holds for the two fragments of unequal size as well as for those of equal size.

We have further evidence, which is as yet hardly complete, that supports the conclusions of the above investigators that "the original polarity of the egg does not necessarily persist in the fragment" (Taylor and Tennent, 1924). Of the number of clear-cut cases, including the ova of both *Patiria miniata* and *Strongylocentrotus purpuratus*, invagination of the blastulae arising from fertilized fragments *occurred on the cut surface*. The number of such cases is twenty-four. We have thus far failed to find any exception to this tendency.

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D. M. WHITAKER

HOPKINS MARINE STATION

THE ANNIVERSARY MEETING OF THE AMERICAN CHEMICAL SOCIETY

THE fiftieth anniversary meeting of the American Chemical Society, being its seventy-second general meeting, was held at Philadelphia, Pennsylvania, from Monday, September 6, to Friday, September 10, inclusive.

Preceding the meeting in Philadelphia, a special pilgrimage was made to the grave of Joseph Priestley at Northumberland, Pennsylvania, where exercises were held, as reported in SCIENCE. The council meeting was held on the morning of the sixth; general meetings on the afternoon of Monday, September 6, and on the afternoon of Wednesday, September 8. Regular divisional meetings were held all day Tuesday, Thursday and Friday and on Wednesday morning. At the general meeting on Monday afternoon, September 6, the following addresses were given: "The Development of Chemical Industry in Italy," by Prince P. Ginori Conti; "The Dyestuff Industry, Forerunner of What?" by Irénée Du Pont; "La Chimie Modern et Marcelin Bertholet," by Paul Sabatier.

On Wednesday afternoon, September 8, diplomas of honorary membership were presented in person to Ernst Cohen, James C. Irvine, W. Lash Miller, Ira Remsen, Theodore W. Richards, Paul Sabatier, Edgar Fahs Smith and Frederic Swarts. A certificate of honorary membership for Joji Sakurai was presented to his proxy, Professor Koichi Matsubara, and a certificate of honorary membership for Charles Moureu was presented through his proxy, Paul Sabatier. Professor Bohuslav Brauner, Professor Giuseppe Bruni, Professor Frederick G. Donnan and Professor Ame Pictet, not being able to be present and having designated no official proxy, their certificates were forwarded to them through other channels.

On the afternoon of Wednesday, September 8, the following addresses were given: "Flames of Atomic Hydrogen," by Irving Langmuir; "Chemical Reaction of Atomic Hydrogen," by Hugh S. Taylor; "Caricature in Science," by Ernst Cohen. After the addresses, a special cash award was presented to Paul Sabatier in the name of the Procter and Gamble Company of Cincinnati in appreciation of his important scientific researches, especially in contact catalysis, which have been so fruitful in making possible successful industrial developments in the soap and fat industries.

On Tuesday evening, September 7, President Norris addressed the society on the subject "A Look Ahead." This address will be printed in the October issue of *Industrial and Engineering Chemistry*. On the same evening the Priestley Medal was awarded to Edgar